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122.

U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

BULLETIN No. 20

PROCEEDINGS

OF THE

SEVENTH ANNUAL CONVENTION

OF THE ASSOCIATION OF

American Agricultural Colleges and Experiment Stations

HELD AT

CHICAGO, ILLINOIS

OCTOBER 17-19, 1893

EDITED BY

A. C. TRUE, for the Office of Experiment Stations
AND
H. E. ALVORD, for the Executive Committee of the Association

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE

WASHINGTON
GOVERNMENT PRINTING OFFICE
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South Dakota—*Brookings:* L. McLouth.§
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Virginia—*Blacksburg:* J. M. McBryde.*
Washington—*Pullman:* E. A. Bryan.*
West Virginia—*Morgantown:* J. A. Myers.*
Wisconsin—*Madison:* W. A. Henry.*
Wyoming—*Laramie:* A. A. Johnson.*

---

* Director.
† President of board of direction.
‡ Assistant director in charge.
§ Chairman of council.
|| Secretary.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., June 5, 1894.

SIR: I have the honor to transmit herewith for publication Bulletin No. 20 of this Office, containing the proceedings of the seventh annual convention of the Association of American Agricultural Colleges and Experiment Stations, held at Chicago, Ill., October 17-19, 1893. The stenographic report of this meeting was made by Mr. S. E. Black, of this Office.

Respectfully,

A. C. TRUE,
Director.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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CONSTITUTION

OF THE

ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

NAME.

This Association shall be called the Association of American Agricultural Colleges and Experiment Stations.

OBJECT.

The object of this Association shall be the consideration and discussion of all questions pertaining to the successful progress and administration of the colleges and stations included in the Association, and to secure to that end mutual coöperation.

MEMBERSHIP.

(1) Every college established under the act of Congress approved July 2, 1862, or receiving the benefits of the act of Congress approved August 30, 1890, and every agricultural experiment station established under State or Congressional authority, the Bureau of Education of the Department of the Interior, the Department of Agriculture, and the Office of Experiment Stations of the last-named Department, shall be eligible to membership in this Association.

(2) Any institution a member of the Association in full standing may send any number of delegates to the meetings of the Association, but one shall be designated to the Association as the regular representative and voting delegate. The same delegate may represent both a college and a station, but shall cast only one vote in general sessions. Other delegates may be designated by any institution to represent it in specified sections of the Association, but such delegates shall vote only in such sections, and no institution shall be allowed more than one vote in any sectional meeting.

(3) Delegates from other institutions engaged in educational or experimental work in the interest of agriculture or mechanic arts may, by a majority vote, be admitted to conventions of the Association, with all privileges except the right to vote.

(4) In like manner, any person engaged or directly interested in agriculture or mechanic arts who shall attend any convention of this Association may be admitted to similar privileges.

SECTIONS.

(1) The Association shall be organized into sections upon (1) college work; (2) agriculture and chemistry; (2) horticulture and botany; (4) entomology; (5) mechanic arts. The executive committee shall, upon the request of any ten institutions represented in the Association, provide for the organization of provisional sections at any convention.

(2) Each section shall conduct its own proceedings and shall keep record of the same, and present a synopsis thereof to the Association at the close of every convention; and no action of a section, by resolution or otherwise, shall be valid until the same shall have been ratified by the Association in general session.

MEETINGS.

(1) This Association shall hold at least one meeting in every calendar year, to be designated as the annual convention of the Association. Special meetings may be held at other times, upon the call of the executive committee, for purposes to be specified in the call.

(2) The annual convention of the Association shall comprise general sessions and meetings of the sections, and provision shall be made therefor in the program. The section meetings may be simultaneous or otherwise, at the discretion of the executive committee, but at least two sections of the Association, to be designated each year by the executive committee, shall present in general session of each convention a portion of the subjects coming before them.

OFFICERS.

(1) The general officers of this Association shall be a president, five vice-presidents, a bibliographer, and a secretary, who shall also be treasurer. The president, junior ex-president, the secretary, and four persons to be chosen by the Association shall constitute an executive committee, which shall elect its own chairman.

(2) Each section shall, by ballot, nominate to the Association in general session, for its action, a chairman and a secretary for such section.

(3) Officers shall be chosen by ballot at the annual convention of the Association, and shall hold office from the close of the convention at which they are elected until their successors shall be chosen.

(4) Any person being an accredited delegate to an annual meeting of the Association, or an officer of an institution which is a member of the Association in full standing at the time of election, shall be eligible to office.

DUTIES OF OFFICERS.

(1) The officers of the Association shall perform the duties which usually devolve upon their respective offices.

(2) The president shall deliver an address at the annual convention before the Association in general session.

(3) The chairman of each section shall make, at the annual convention, a report to the Association in general session of the progress during the preceding year of the subject or subjects appertaining to his section, and such reports shall not occupy more than twenty minutes each.

(4) The executive committee shall determine the time and place of the annual conventions and other meetings of the Association, and shall, between such conventions and meetings, act for the Association in all matters of business. It shall issue its call for the annual conventions of the Association not less than sixty days before the date on which they are to be held, and for special meetings not less than ten days before such dates. It shall be charged with the general arrangement and conduct of all meetings called by it. It shall designate the two sections to present in general session a portion of the subjects coming before them, and shall give notice thereof to the chairmen of such sections at least ninety days prior to the annual convention. It shall provide a well-prepared order of business and a program of exercises, and shall make a seasonable issue of said program. Said committee may fill any vacancy in an office or committee of the Association occurring after the adjournment of the annual convention, such appointee to serve until the next annual election.

FINANCES.

At every annual convention, the Association, in general session, shall provide for obtaining the funds necessary for its legitimate expenses, and may, by appropriate action, call for contributions upon the several institutions eligible to membership; and no institution shall be entitled to representation or participation in the benefits of the Association unless such institution shall have made the designated contribution for the year previous to that in and for which such question of privilege shall arise, or shall have had said payment remitted by the unanimous vote of the executive committee.

AMENDMENTS.

This constitution may be amended at any regular convention of the Association by a two-thirds vote of the delegates present, if the number constitute a quorum: *Provided*, That notice of any proposed amendment, together with the full text thereof and the name of the mover, shall have been given in the call for the convention. Every such proposition of amendment shall be subject to modification or amendment in the same manner as other propositions, and the final vote on the adoption or rejection shall be taken by yeas and nays of the institutions then and there represented.

RULES OF ORDER.

(1) The executive committee shall be charged with the order of business, subject to special action of the convention, and this committee may report at any time.

(2) All business or topics proposed for discussion and all resolutions submitted for consideration of the convention shall be read and then referred, without debate, to the executive committee, to be assigned positions on the program.

(3) Speakers invited to open discussions shall be entitled to twenty minutes each.

(4) In general discussions the ten-minute rule shall be enforced.

(5) No speaker shall be recognized a second time on any one subject while any delegate who has not spoken thereon desires to do so.

(6) The hours of meeting and adjournment adopted with the general program shall be closely observed, unless changed by a two-thirds vote of delegates present.

(7) The presiding officer shall enforce the parliamentary rules usual in such assemblies and not inconsistent with the foregoing.

OFFICERS OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

President:

S. D. LEE, of Mississippi.

Vice-Presidents:

G. E. MORROW, of Illinois;
H. HADLEY, of New Mexico;
J. S. NEWMAN, of South Carolina;
J. H. CANFIELD, of Nebraska;
WILLIAM FREAR, of Pennsylvania.

Secretary and Treasurer:

M. A. SCOVELL, of Kentucky.

Bibliographer:

S. W. JOHNSON, of Connecticut.

Executive Committee:

The PRESIDENT; the JUNIOR EX-PRESIDENT (W. A. Henry, of Wisconsin); the SECRETARY;
H. E. ALVORD, the District of Columbia;
A. W. HARRIS, of Maine;
H. C. WHITE, of Georgia;
H. H. GOODELL, of Massachusetts.

Chairmen of Sections:

Agriculture and Chemistry, W. A. HENRY, of Wisconsin;
Botany and Horticulture, E. S. GOFF, of Wisconsin;
College Work, GEO. T. FAIRCHILD, of Kansas;
Entomology, H. OSBORN, of Iowa;
Mechanic Arts, J. H. WASHBURN, of Rhode Island.

Secretaries of Sections:

Agriculture and Chemistry, E. B. VOORHEES, of New Jersey;
Botany and Horticulture, L. H. PAMMEL, of Iowa;
College Work, H. E. STOCKBRIDGE, of North Dakota;
Entomology, C. M. WEED, of New Hampshire;
Mechanic Arts, F. P. ANDERSON, of Kentucky.

LIST OF DELEGATES AND VISITORS IN ATTENDANCE.

Alabama:

College: A. J. Bondurant, professor of agriculture.

Arizona:

Station: F. A. Gulley, director.

Arkansas:

Station: R. L. Bennett, director.

Colorado:

College: A. L. Kellogg, trustee.

Station: C. P. Gillette, entomologist.

Connecticut:

College: *Storrs*—B. F. Koons, president; E. H. Hyde, trustee.

Station: *State*—W. C. Sturgis, mycologist.

Georgia:

College: J. B. Hunnicutt, professor of agriculture.

Station: H. N. Starnes, horticulturist.

Idaho:

Station: J. M. Jones, superintendent substation.

Illinois:

College: G. E. Morrow, dean of agriculture; I. S. Raymond, trustee.

Station: E. H. Farrington, chemist.

Indiana:

College: H. A. Huston, professor of agricultural chemistry.

Station: C. S. Plumb, director.

Iowa:

College: L. H. Pammel, professor of botany.

Station: James Wilson, director; C. F. Curtiss, assistant director.

Kansas:

College: G. T. Fairchild, president; Joshua Wheeler, regent; W. D. Street, regent; N. S. Mayo, professor of veterinary science and physiology.

Kentucky:

College: J. K. Patterson, president; F. P. Anderson, professor of mechanical engineering; W. A. Patterson, tutor.

Station: M. A. Scovell, director.

Louisiana:

College (Southern University, New Orleans): Hugh Jamieson, jr., professor of agriculture.

Maine:

College: A. W. Harris, president.

Station: Walter Balentine, agriculturist.

Maryland:

College: R. W. Silvester, president; W. T. L. Taliaferro, professor of agriculture.

Station: R. H. Miller, director.

Massachusetts:

College: W. H. Bowker, trustee.

Station: *State*—C. A. Goessmann, director.

Michigan:

College: C. D. Smith, professor of agriculture; A. C. Glidden, trustee.

Minnesota:

College: M. H. Reynolds, professor of veterinary science.

Station: W. M. Hays, agriculturist.

Mississippi:

College: W. C. Welborn, professor of agriculture; C. L. Steele, professor of military science and tactics.

Station: W. L. McGee, assistant director.

Missouri:

College: E. D. Porter, dean.

Montana:

Station: S. M. Emery, director.

New Jersey:

College: Austin Scott, president.

New Hampshire:

College: C. S. Murkland, president.

New Mexico:

College: Hiram Hadley, president.

Station: J. D. W. Veeder, member board of control.

New York:

College: J. H. Comstock, professor of entomology.

Station: *Cornell*—I. P. Roberts, director.

North Carolina:

Station: H. B. Battle, director.

North Dakota:

College: H. E. Stockbridge, president.

Station: T. D. Hinebauch, veterinarian.

Ohio:

College: W. R. Lazenby, professor of horticulture; Thos. F. Hunt, professor of agriculture; N. S. Townshend, *emeritus* professor of agriculture; H. A. Weber, professor of agricultural chemistry; H. J. Detmers, professor of veterinary surgery.

Station: C. E. Thorne, director; J. F. Hickman, agriculturist; S. H. Ellis, R. H. Warder, J. H. Brigham, members board of control.

Oklahoma:

College: A. C. Magruder, professor of agriculture.

Pennsylvania:

College: G. W. Atherton, president; W. H. Caldwell, assistant professor of agriculture.

Station: H. P. Armsby, director; W. Frear, vice-director and chemist.

Rhode Island:

College: J. H. Washburn, president.

Station: C. O. Flagg, director.

South Carolina:

College: E. B. Craighead, president.

South Dakota:

College: L. McLouth, president.

Tennessee:

College: C. W. Dabney, jr., president.

Station: C. F. Vanderford, secretary.

Texas:

College: A. J. Rose, W. R. Cavitt, trustees.

Vermont:

Station: J. L. Hills, director.

West Virginia:

College: J. A. Robinson, J. S. Withers, trustees.

Station: J. A. Myers, director.

Wisconsin:

College: W. A. Henry, dean.

Station: F. W. Woll, assistant chemist.

Wyoming:

College: G. R. Hebard, secretary board of trustees.

Station: B. C. Buffum, horticulturist and meteorologist.

U. S. Department of Agriculture:

H. E. Alvord, special agent.

Office of Experiment Stations:

A. C. True, director; S. E. Black, private secretary.

Bureau of Education:

J. W. Holcombe, chief clerk.

Canada:

Ontario Agricultural College: C. A. Zavitz.

Provincial School of Agriculture: H. W. Smith, principal.

CALL FOR THE CONVENTION.

By authority of the executive committee a delegate convention of this Association is hereby called to meet in the city of Chicago, Ill., on Tuesday, October 17, 1893, at 10 o'clock a. m.

Attention is called to Article III of the revised constitution of the Association, entitled "Membership," and which is as follows:

(1) Every college established under the act of Congress approved July 2, 1862, or receiving the benefits of the act of Congress approved August 30, 1890, and every agricultural experiment station established under State or Congressional authority, the Bureau of Education of the Department of the Interior, the Department of Agriculture, and the Office of Experiment Stations of the last-named Department shall be eligible to membership in this Association.

(2) Any institution a member of the Association in full standing may send any number of delegates to the meetings of the Association, but one shall be designated to the Association as the regular representative and voting delegate. The same delegate may represent both a college and a station, but shall cast only one vote in general sessions. Other delegates may be designated by any institution to represent it in specified sections of the Association, but such delegates shall vote only in such sections, and no institution shall be allowed more than one vote in any sectional meeting.

(3) Delegates from other institutions engaged in educational or experimental work in the interest of agriculture may, by a majority vote, be admitted to conventions of the Association, with all privileges except the right to vote.

(4) In like manner, any person engaged or directly interested in agriculture who shall attend any convention of this Association may be admitted to similar privileges.

In accordance with Article VII, the Section on Agriculture and Chemistry and the Section on Mechanic Arts are designated "to present in general session a portion of the subjects coming before them."

The program for the session and other particulars will be announced later.

The several agricultural congresses of the World's Congress Auxiliary of the Columbian Exposition will be held in Chicago, October 16–28, and it is intended that the sessions of this Association shall be arranged in harmony therewith.

For the executive committee:

Henry E. Alvord,
Chairman.
M. A. Scovell,
Secretary.

Washington, D. C., *July 15, 1893.*

PROGRAM.

TUESDAY, OCTOBER 17, 1893.

10 a. m.—General session. Organization, committee reports, etc.
2 p. m.—Meetings of the sections for business and further arrangements.
8 p. m.—General session. In union with the World's Agricultural Congress.

1. Annual address by the President of the Association.
2. Introduction of Sir Henry Gilbert, special delegate from the Lawes Agricultural Trust, Rothamsted, England.

WEDNESDAY, OCTOBER 18, 1893.

10 a. m.—General session for business, election of officers, etc.
Subject for discussion and action: The Association and the Exposition.
2 p. m.—Meetings of all the sections.
7 p. m.—General session.

1. Subjects presented by Section on Agriculture and Chemistry.
2. Subjects presented by the Section on Mechanic Arts.
3. Final adjournment of general session, unless otherwise ordered.

THURSDAY, OCTOBER 19, 1893.

10 a. m., 2 p. m., and 7 p. m.—Meetings of the sections.

The World's Agricultural Congresses hold sessions on the afternoons and evenings of the same week.

PROCEEDINGS.

MORNING SESSION, TUESDAY, OCTOBER 17, 1893.

The convention was called to order at 10:20 a. m., in room No. 4, Art Institute, on the Lake front, head of Adams street, Chicago, by President Henry.

The PRESIDENT. Gentlemen: In accordance with the call of the executive committee, issued July 15, we have met for this, the seventh, annual convention of the Association of American Agricultural Colleges and Experiment Stations. Allow me to call your attention to the report of the proceedings of our last convention, held at New Orleans last November, copies of which most of you probably received before leaving home. It has been suggested that the section of the constitution relating to membership be read, and I will call on the secretary to read it.

The secretary read the section of the constitution relating to membership.

The report of the executive committee was submitted by Henry E. Alvord, chairman.

REPORT OF THE EXECUTIVE COMMITTEE.

Immediately after the adjournment of the convention of 1892 this committee met at New Orleans and organized, selecting Henry E. Alvord as chairman and M. A. Scovell as secretary.

The committee has performed the duties with which it was charged by the last convention, as far as practicable, and, in accordance with the revised constitution of the Association, has called the present meeting and made the necessary arrangements therefor. A very general expression of preference for Chicago made it an easy matter to decide upon this city as the place of meeting. There was some difference of opinion as to the time, but it was decided in order to accord with the previous assignment of the World's Agricultural Congress to the period from October 16 to 20, inclusive. In consideration of the attractions of the World's Columbian Exposition and of the Congress mentioned, it has been deemed expedient to reduce the program for the convention to the minimum consistent with the constitution, so far as general sessions are concerned, and to leave the several sections to decide for themselves the character and duration of their sessions. These considerations have made it impracticable to conform closely this year to the suggestions contained in two resolutions regarding the length and character of the annual convention, which were referred at New Orleans to this committee.

Since the last convention there has been little for this committee to do except to execute the instructions of that convention. The main work has been in connection with the interests of the Association and the institutions represented by it at the Columbian Exposition.

The standing committees in charge of the collective exhibits of the colleges and stations were greatly aided and supported in their work by the advisory board elected by the New Orleans convention. It may be remarked in passing that this experience shows the advantage of having members of the governing boards appointed as delegates from our different institutions, and of bringing them into the active work of the Association.

The executive committee in charge of the collective college exhibit found that, notwithstanding the active coöperation of many of the colleges and such assistance as the Department of Agriculture was able to give, it would be necessary to have special funds to make this exhibit a success. Senator Morrill and the advisory board were very helpful in this matter, and an appropriation of $8,000 was obtained from Congress, to be disbursed under the supervision of the Department of Agriculture. That Department appointed as its special agent for this business the chairman of the Association committee, and the work of collecting and placing this college exhibit, although late, was carried to completion in a manner which, it is hoped, may meet with the approbation of those interested. Every college prepared and packed its own contributions, defraying all incidental expenses to time of shipment. At that point the General Government took charge, and all further expenses have been met from the special appropriation for the purpose. Thus the demand upon the treasury of the Association in connection with the exhibit has been very light, being almost wholly confined to the expenses of the committees appointed by the Association to care for its interests. Without further comment, reference is made to the exhibit itself as the best report of its work which the committee can now render. But it is believed that there should be some permanent descriptive record of this exhibit, and authority is requested on behalf of the present committee to file a general report on the exhibit with the new executive committee.

The committee on the college exhibit has worked, as directed, in conjunction with the committee on the station exhibit and although really two divisions the result may be regarded as one joint and collective exhibit of the colleges and stations. Since the installation was completed the management has been on the basis of a single exhibit, and this has included the display of the Office of Experiment Stations of the Department of Agriculture. That office has carried, very acceptably, the greater part of the administration of the exhibit, arranging with the different institutions for the detail of college and station men who have served in turn, from month to month, as attendants, guardians, and demonstrators for the exhibit.

The attention of the Association is invited to the comprehensive and attractive exhibit made by the Government of France of the means and methods of the various branches of agricultural education in that country. This exhibit is in the Agricultural Building of the Exposition, immediately adjoining the similar American exhibits, and, as the former has not been entered for competition, it is suggested that this convention might well ask of the Exposition authorities some special examination and official recognition of this excellent French exhibit.

The Association has been represented on the committee supervising the tests of breeds of dairy cattle at the Exposition, in accordance with the action of the convention at New Orleans, and a report may be expected from the testing committee. The executive committee was charged with the duty of providing for payment of the necessary expenses of the four Association members of the testing committee, upon consultation with these gentlemen, and authority was given to call for an extra contribution to the treasury of the Association for this purpose. It has not seemed expedient to make such a special call for funds the present year, when the various institutions have been taxed in several ways on account of the Exposition. Other methods have been tried in the hope of relieving the treasury of the Association from this particular and rather large item of expense. These have failed, however, and the committee now refers the whole question back to the Association for settlement. The subject of the relations of the Association and the Exposition has accordingly been assigned for consideration and action at the general session of this convention on

Wednesday morning. It should be stated, however, that the ordinary income of the Association has enabled the payment of the expenses of the testing committee up to July 1, as well as all other obligations of the Association to date, and it is therefore recommended that arrangement be made for carrying over to the next year the remaining cost of this special committee, amounting to about $1,000, and providing for such increased revenues then as will cancel this debt from the general treasury.

A committee was appointed, as ordered, to coöperate, on behalf of this Association, with the general committee of the World's Congress Auxiliary upon Agricultural Congresses. A statement of the duties performed may be expected from Prof. Morrow.

The chief of the department of agriculture of the Exposition was duly notified of the willingness of the Association, through its executive committee, to coöperate in arranging for a series of popular lectures on agriculture at the Exposition, but after a few trials in June, Chief Buchanan wisely concluded to abandon this project.

Your committee reports that upon investigation, as directed, it has been ascertained that Preston Powers, sculptor (son of the famous Hiram Powers), has, at his studio in Florence, Italy, an original model, or mold, of a bust of Hon. Justin S. Morrill, taken about the time of the passage of the first land-grant college, or Morrill, Act (1862). A plaster cast from this model is now to be seen at the central space of the collective college exhibit. Mr. Powers offers to make a new marble bust from this mold, and from this to have twenty-five plaster casts made, everyone to receive his personal attention and final approval, if guaranteed the sum of $800. If a larger number were ordered, the price of each bust could be materially reduced. Forty could be obtained at about $25 each. In any case the marble would become the property of the subscribers for the casts, and it is suggested that this might be deposited, in the name of the Association, at some suitable place in Washington and that other casts might be made from it subsequently. It should be understood that the casts proposed to be made by Mr. Powers represent an article much superior in quality and finish to the ordinary plaster casts for museum purposes.

In accordance with the instructions of the New Orleans convention, a subcommittee of the executive committee met the President-elect of the United States by appointment in New York in the month of February last. The condition and work of the colleges and stations in the several States were presented, and their relations to the General Government were discussed. The scientific work of the Department of Agriculture was also considered. Subsequently the same committee had a similar interview at Washington with the newly-appointed Secretary of Agriculture. The President and Secretary both expressed themselves as fully appreciating the work of the colleges and stations and as desirous of coöperating in the promotion of the welfare of these institutions and of the interests by them represented.

It was found impracticable to secure the attention of the new Secretary of the Interior to the matter of the several reports required from college officers before the close of the last fiscal year. Since that time the period of college vacations and the opening of the new academic year have combined, with other things, to prevent the desired conference on this subject. Your committee reports this as the one duty committed to it by the last convention which has not yet received attention, but suggests that time still remains for this work to be done before the next annual reports become due.

The Association at its last convention appointed a special committee to consider and report upon a system for uniform station publications. This committee duly reported through its chairman, A. W. Harris, and the report is submitted herewith. It was at first intended to publish and distribute this report soon after its completion, but it was finally decided to postpone such action until after the distractions of the Exposition year. It is now recommended that this report be referred to the new executive committee for publication and distribution, and that it be also incorporated in the proceedings of this convention.

Another special committee was appointed at New Orleans upon college statistics, with instructions to report to the convention of 1893, and President Atherton, as chairman of the committee, is prepared to comply.

Since the last annual meeting the executive committee has issued twelve circulars of information, most of them in connection with Exposition matters. These have been distributed to all institutions eligible to membership under the constitution of the Association, as revised. Now that this constitution has been printed, it is recommended that every institution eligible to membership be furnished a copy, with attention called to conditions of membership, and be served with notice that hereafter no institution will be recognized as entitled to share in the work and benefits of the Association unless it be a member thereof in full standing.

The annual contribution of $10, agreed upon at the last convention, has been very generally paid and has proved sufficient, together with last year's balance, for the needs of the Association to date, excepting, as already noted, the expenses of the dairy test committee since the 1st of July. The treasurer's report will show a balance from last year of $416.54, with collections of $860, making the total receipts $1,276.54; disbursements in all amounted to $1,266.91, leaving a balance of $9.63 on hand at the present time. The obligations of the Association on account of its representation on the dairy test committee of the Exposition will amount to about $1,000 at the close of the present month. It is believed that the simplest and most equitable manner of meeting this unusual expenditure is by a sufficient increase in the annual contribution asked for next year. The committee therefore recommends that the dues for the coming year be fixed at $15 for every eligible institution, believing that this will enable the Association to free itself from debt. The executive committee should also be authorized to make special call for additional funds in case of need, although this does not appear likely. It is further suggested that some special means be taken to impress upon all interested that no matter how close the actual relation of college and station in any State, or as part of one institution, this Association regards every college and every station as a distinct and separate institution for purposes of taxation and representation.

Under existing circumstances, it has been thought unnecessary to issue any program for the present convention other than the schedule for meetings contained in the supplementary convention circular. It is now recommended that that be adopted, subject to the further pleasure of the convention, and also that the precedents of recent conventions be followed as to credentials and rules of order.

Respectfully submitted for the executive committee.

HENRY E. ALVORD,
Chairman.

CHICAGO, ILL., *October 17, 1893.*

Mr. HADLEY. I move that the report be accepted and that it be considered in its various recommendations seriatim at the proper time.

Seconded by Mr. Scott.

The motion was carried.

The report of the treasurer was then presented by Mr. Scovell.

REPORT OF THE TREASURER OF THE ASSOCIATION.

M. A. Scovell, treasurer, in account with Association of American Agricultural Colleges and Experiment Stations.

Balance on hand at last meeting	$416.54
Moneys received since last meeting—dues 1892–'93	860.00
Total	1,276.54
Expenditures	1,266.91
Balance on hand	9.63

REPORT OF THE TREASURER OF THE ASSOCIATION—Continued.

EXPENDITURES.

Stationery and printing	$70.90
Subcommittee to see President, etc. (expenses)	248.11
Dairy test committee	818.16
College and station exhibit committee (expenses)	44.70
Stenography	49.29
Sundries	35.75
Total, as above	1,266.91

ITEMIZED STATEMENT.

Receipts.

1893.			
April	1.	Ohio Experiment Station	$10.00
	3.	North Carolina Experiment Station	10.00
	3.	Georgia Experiment Station	10.00
	3.	Experiment Station, University of Tennessee	10.00
	3.	Delaware College	10.00
	6.	Maine State College	10.00
	6.	Agricultural Experiment Station of West Virginia	10.00
	6.	University of Minnesota Experiment Station	10.00
	6.	Kentucky Agricultural Experiment Station	10.00
	6.	Michigan Agricultural College	10.00
	6.	Michigan Experiment Station	10.00
	7.	Louisiana Experiment Station	10.00
	7.	Maryland Agricultural College	10.00
	7.	Maryland Experiment Station	10.00
	8.	Mississippi Agricultural College	10.00
	8.	Mississippi Experiment Station	10.00
	8.	Massachusetts Agricultural College	10.00
	8.	Hatch Experiment Station	10.00
	8.	Kentucky Agricultural and Mechanical College	10.00
	10.	Ohio State University	10.00
	10.	New Hampshire College of Agriculture and Mechanic Arts	10.00
	11.	Vermont State Agricultural College	10.00
	12.	Cornell University	10.00
	12.	Cornell Experiment Station	10.00
	12.	Purdue University	10.00
	12.	Alabama Experiment Station	10.00
	12.	Alabama Agricultural and Mechanical College	10.00
	12.	Arizona Experiment Station	10.00
	12.	Arizona Agricultural College	10.00
	12.	University of Wisconsin	10.00
	15.	Virginia Agricultural and Mechanical College	10.00
	15.	Virginia Agricultural Experiment Station	10.00
	15.	Rhode Island State Experiment Station	10.00
	15.	Arkansas Agricultural Experiment Station	10.00
	17.	Vermont Agricultural Experiment Station	10.00
	17.	Indiana Experiment Station	10.00
	17.	Delaware Agricultural Experiment Station	10.00
	17.	Iowa Experiment Station	10.00
	20.	North Carolina College of Agriculture and Mechanic Arts	10.00
	24.	Sheffield Scientific School of Yale University	10.00

Report of the Treasurer of the Association—Continued.

Receipts—Continued.

1893.			
May	1.	Connecticut Agricultural Experiment Station	$10.00
	5.	Massachusetts State Experiment Station	10.00
	6.	Colorado Agricultural College	10.00
	6.	Storrs Agricultural Experiment Station	10.00
	6.	Nevada Experiment Station	10.00
	6.	Nevada Agricultural College	10.00
	8.	Experiment Station of University of Wisconsin	10.00
	8.	Agricultural College of University of Idaho	10.00
	8.	University of Minnesota	10.00
	8.	Rhode Island College of Agriculture and Mechanic Arts	10.00
	12.	California Experiment Station	10.00
	12.	New Jersey State Experiment Station	10.00
	13.	Maine Experiment Station	10.00
	15.	New Hampshire Experiment Station	10.00
	17.	New Mexico Experiment Station	10.00
	17.	New Mexico Agricultural and Mechanical College	10.00
	20.	Iowa Agricultural College	10.00
	24.	Kansas Experiment Station	10.00
	24.	Kansas State Agricultural College	10.00
	26.	Illinois Experiment Station	10.00
June	6.	Colorado Experiment Station	10.00
	16.	Utah Agricultural College	10.00
	16.	Utah Experiment Station	10.00
	16.	South Dakota Experiment Station	10.00
July	10.	Wyoming Agricultural College	10.00
	10.	Wyoming Experiment Station	10.00
	10.	Nebraska Experiment Station	10.00
	13.	Rutgers College	10.00
	14.	Pennsylvania Experiment Station	10.00
Aug.	14.	Texas Agricultural College	10.00
	17.	Oregon Experiment Station	10.00
	18.	Florida Agricultural College	10.00
	28.	Louisiana State University	10.00
	28.	University of Georgia	10.00
	29.	Texas Experiment Station	10.00
	31.	University of Tennessee	10.00
Sept.	1.	Nebraska State University	10.00
	6.	Missouri Experiment Station	10.00
	6.	Missouri Agricultural and Mechanical College	10.00
	18.	Alcorn Agricultural and Mechanical College, Mississippi	10.00
	23.	South Carolina Experiment Station	10.00
	27.	University of Illinois	10.00
	29.	West Virginia University	10.00
Oct.	4,	Pennsylvania State College	10.00
	11.	Hampton Normal and Agricultural Institute	10.00
	16.	Oklahoma Experiment Station	10.00

On motion of Mr. Harris the report of the treasurer was referred to an auditing committee of three, appointed by the chair, consisting of Messrs. Harris, Emery, and Vanderford.

The PRESIDENT. The secretary asks me to announce that anyone who desires to see the items of expenditures may do so by calling upon him. It has been suggested that the several sections be called upon for their reports at this time. As chairman of the Section of Agriculture and Chemistry I make their report in these words. It has been considered best to drop the work on account of the Columbian Exposition.

We will next have the report of the chairman of the Section on Botany and Horticulture.

The chairman of the section, Mr. Scribner, of Tennessee, was not present, and no report of the section was presented.

Mr. Dabney, of Tennessee, chairman of the Section on College Work, submitted his report.

REPORT OF THE SECTION ON COLLEGE WORK.

As chairman of the Section on College Work it is my duty to make a report at this session, to occupy not exceeding twenty minutes in the reading. As it would be impossible to treat any large part of our college work in this brief time, we have sought some special phase of our work which seemed to need notice and might be profitably discussed within the limit fixed. In previous reports of our presidents and of the chairmen of the different sections we have had able discussions of almost every other department of our colleges, and we have, therefore, selected the military instruction and drill as a subject which may well receive our attention at this time.

As national colleges endowed with the proceeds of the sale of a portion of the national domain, we are especially charged with the general duty of educating our pupils in patriotism and the special duty of instructing the young men of the country in military science and tactics, so as to form a basis of a national guard in the hour of need. The Land-Grant Act was passed in 1862. The National Government was at that time greatly impressed with the importance of a class of young men educated in military science and having some experience in drill, who might be called upon to organize and command the volunteer armies when the nation needed their services. May the Nation never see just that need again! We never shall, but the experience of that time must be used in preparing for the future.

Later experience has shown that our States must be prepared at all times to put down mobs and riots. As our population becomes more dense and more mixed it is evident that we will have more and more use for strong State militia. Recent events in some of our States teach us that the way to keep the peace is to be well armed. It is well, therefore, that these national colleges were charged with the duty of training young men who might form a class of reserved military officers.

The act of July 2, 1862, requires, thus, that military tactics shall be included among the studies at these colleges. This is not left optional with the States or the management of the institutions, but this instruction is mandatory. The legislatures of the States may prescribe the manner in which all of the instruction at these colleges is to be given, but the "branches of learning related to agriculture and the mechanic arts" and "military tactics" must be taught. Other scientific and classic studies may be included, but there is no option about these subjects. Although we do not believe that military drill has been as well provided for as it might be, the Government has done a great deal for us by detailing officers from the Army, who will serve as instructors, and by the loan of a limited equipment.

Let us at this time inquire briefly into the instruction and practice given in military science and tactics in our colleges for the purpose of seeing what its needs are and what improvements may be made.

According to the latest organization list of agricultural colleges published by the Department of Agriculture there are 61 colleges receiving the benefits of the Land Grant, counting 2 for Massachusetts, 2 for Rhode Island, 2 for Connecticut, and 10 separate colleges or departments for colored students. As the latter are practically departments only we may include them with their State institutions. We have, thus, 51 separate State institutions under this Association. Thirty-seven of these have officers detailed from the U. S. Army to serve as professors of military science and tactics. Eleven out of these 51 Land-Grant colleges, chiefly new institutions not yet fully organized, have not as yet provided any regular military instruction. Two of them give some instruction in military science and drill, although they have no Army officers. It is probable that all of these institutions could have Army officers if they applied for them. The present law allows 85 to be detailed from the regular Army, and an unlimited number of retired officers, who must, of course, be paid salaries. An institution, however, which employs a retired officer can get the military equipment from the War Department.

We learn from the reports of these colleges and of the Inspector General of the Army that efficient work is being done in a majority of the colleges. Some show a want of appreciation of military science and drill as both educating and deciplinary subjects and a very few show a disposition to neglect or slight this department. We believe such colleges make an error. On the one hand for training men in habits of order, system, neatness, promptitude, obedience to constituted authority, and working together with their fellows the military drill is unsurpassed.

There can be no question as to our duty to the nation and our States. In a majority of the States these are the only military colleges. We beg such institutions to consider this instruction and practice more seriously.

According to the report of the Commissioner of Education there were, in 1889–'90, 9,433 students in attendance upon these colleges. Of this number 3,000 were in preparatory departments and 700 were women. As a rule all the preparatory students are required to take military drill, but many advanced and graduate students are excused from it. We estimate that there were still at least 8,000 young men in the military departments in these various colleges in 1889–'90. Ten thousand would be a moderate estimate for the number in 1892–'93—a small army in itself.

The gentlemen here present are all familiar with the details of instruction and practice in the military departments of these institutions. I will not, therefore, go into this subject at any length. It is interesting, however, to note the extremes, especially in regard to the time allowed and the number of classes required to take the work.

We have among our agricultural colleges illustrations of almost all forms of military government, organization, and instruction. Many of these institutions started out with military departments modeled as closely as possible after that at West Point. The older colleges, having a single course of study, with few electives, and located in the country where all of their students lived in dormitories, found that organization entirely practicable. It was especially useful so long as their student body contained many preparatory students and boys. Our country boy made an admirable cadet and profited much by this discipline and instruction. Other institutions located in towns, without or with only limited dormitories, and having, therefore, to put their students in private families, attempted the same plan, but they have, we believe, without exception, abandoned it. In these cases the Army officer was commandant of cadets and in charge of the discipline, as well as professor of military science and tactics. He was the autocrat of the college and controlled everything, including, in some cases, the other professors and their departments.

The other extreme is the large university having many older and more advanced students and many different courses and classes. In such institutions military instruction is usually confined to one or two classes and to its own hours, as the other instruction is. Military government has been wholly abandoned in such cases, and the military professor has no more authority than any other. As our colleges developed and multiplied courses, and especially as the demand grew for work in laboratories, shops, and on farms, the organization of the military departments has been steadily modified in the direction of the latter system.

Older students find continued military drill very irksome. They consider it a hardship to have to give so large a portion of their time to it, when they have no intention of becoming professional soldiers. The juniors and seniors in our college courses taking either literary, scientific, engineering, or agricultural work are in these days completely overloaded with library, seminary, laboratory, and other practical work, and have little time for practical military work. The best of them may be induced to volunteer for this work, as is the custom in many of our colleges, by making military work an elective in science, and giving full credit for it; but it is still a problem in such institutions how to get the very best men for officers.

As all of our colleges must come to this standard sooner or later, the question for us to consider is: How shall we do our duty to the nation in respect to the training of young men in military science and tactics without interfering too seriously with the other work that we are required to do? In other words, how shall we train the citizen soldiery that the country needs and still give all of our students the "liberal and practical education" which is the chief object of these colleges?

The rules prescribed by the President for the government of officers of the Army detailed as professors of military science and tactics are contained in General Orders No. 26, 1891. They require that "the course of instruction shall be both practical and theoretical, and shall be so arranged as to occupy at least one hour per week for theoretical instruction, and at least two hours per week for practical instruction." From an examination of the reports of the various institutions I gather that the average time given to military instruction and practice is greater than this. It is probably nearer four hours per week than three.

It is left to each institution to decide what classes of students are subject to this theoretical and practical instruction. This is the main point of variation between our colleges and the most important one to be guarded. On the one hand, if the students are not required to drill in sufficient numbers and for a sufficient length of time, the institution will not have a respectable battalion, and no proficiency will be attained in the art of war. On the other hand, if it is continued too long, it becomes irksome to the student and detracts from his success in other studies. The majority of our larger institutions have, we believe, reached a proper compromise by requiring all male members of their colleges below the junior class, or third year (counting from the beginning), to take military drill, and by requiring the second-year men and all commissioned officers to receive theoretical instruction. The members of the junior and senior classes and of other departments of the university may volunteer for not less than one term of service at a time, and are encouraged to do this, whenever they have military experience, by giving them commissions as officers and credits for this work on the college course. The course of military instruction and drill should, in all cases, be a part of the regular college course and be duly credited to the student as other recitation or practical work is.

Under this plan the student is subject to drill at the period when he needs it most and can best spare the time. It is also found to be the period when he can learn it most rapidly. The boy who has had military drill for two years and acquired no special interest in it is only an obstruction in his company afterward if he is compelled to drill. If not fit for an officer after two years of drill, he had better be dropped from military instruction, as he will never make an enthusiastic soldier. This plan gives the military department the best material for privates and also the best material for officers, while at the same time it gives the college the full time of all advanced men, not specially interested in military matters, for literary or scientific work.

The original act (section 1225 of the Revised Statutes) provides that the Secretary of War may issue "at his discretion and under proper regulations to be prescribed by him, out of ordnance and ordnance stores belonging to the Government and which can be spared for that purpose, such a number of the same as may appear to be required for military instruction and practice by the students of any college or university, under the provisions of this section; and the Secretary shall require a bond in each case in double the value of the property," etc.

It is right that the property of the Government should be properly cared and accounted for, but in this whole matter of securing and accounting for military equipment and supplies these institutions and their officers are treated as if they were aliens to the Government, instead of a part of it. They are required to pay the freight on all equipment and supplies, to insure the Government property at the valuation placed upon it by the War Department (which is considerably more than its actual value), to pay the cost of all repairs, to pay for gun racks and other necessary armory furniture, to pay for all damaged and missing stores, and after they are worn out to return the débris to a national arsenal "without expense to the United States."

If we are a part of the nation and doing the nation's work, we fail to see the fairness of all this. Why should not these departments be recognized as army posts and be supplied with equipment under the same conditions as other army posts? The Government has its own officer in charge and can hold him responsible for these things under its rules. It would seem to us much fairer and certainly much simpler if the officer in charge of the instruction at each institution could make his requisition for what he wanted, have it supplied, and account for it, or return it at the Government's expense. Why should these institutions be required to pay the freight upon and repair Government property when they are using it for Government purposes? By a strange misunderstanding, this legislation, which treats us as national institutions in most matters, changes its spirit entirely as soon as it comes to this matter of military property. Is there any reason for this? We have been able to find none and must attribute it either to misunderstanding or to "red tape." If the War Department could only treat these institutions as army posts in charge of their own officers, the method of supplying equipment, etc., could, we believe, easily be modified as we suggest and in full accordance with their rules.

The Government does not supply nearly all the military equipment required. Some provision should be made for supplying uniforms, gun racks and armory furniture, side arms, band instruments, flags, tentage, and especially for the care and repair of the Government's property.

In this connection I wish to call especial attention to the recommendation contained in the report of the Inspector General of the Army for the year 1892. The Inspector General recognizes the national character of these institutions and the importance of the work they are doing in training officers for any great emergency, and favors, if we understand correctly, a more intimate relation between these colleges and the War Department. He recommends, therefore, that the Government supply all of the equipment for them, including uniforms. He says (p. 13):

"The objects of the law, therefore, are manifestly national in their character, and while the student and the college derive some benefit from the instruction received, it should not be forgotten that the time devoted to such instruction is necessarily taken away from the time which would be ordinarily given to other college pursuits, and therefore must be regarded by the student as more or less a sacrifice. Indeed, there are those who consider it a great hardship, which they seek by every conceivable excuse to avoid. It would seem, therefore, no more than right to relieve them from the special expense of preparation for military service under the U. S. Government. It should be made easy and desirable for the youth of the country to train themselves for the national defense.

"In many of the institutions where military instruction is now given, the difficulty of procuring the necessary uniforms and camp and garrison equipage is so great as to almost preclude it, and in all cases, owing to lack of experience, such articles can only be obtained at higher prices comparatively than those paid by the U. S. Government, which buys in large quantities under an efficient system of supply."

The Inspector General then refers to a joint resolution which was introduced in the last Congress authorizing the Secretary of War to supply these colleges with additional equipment, and concludes:

"I therefore earnestly recommend such legislation as will enable the Secretary of War to sell to military colleges such articles as it is legal and practicable to furnish with the means now at our disposal, and that hereafter, or as soon as the amount can be determined, an annual appropriation be made for the purpose embraced in the joint resolution, to be expended by the Secretary of War on such conditions and regulations as Congress may prescribe."

This recommendation certainly seems just. The majority of the students in these institutions are poor. They are, we will venture to say, as a class, the most earnest and promising, while they are the least wealthy class of students in our country. The cost of this uniform is a considerable thing to them, amounting frequently to one tenth of their whole year's expenses. This expense keeps, to our certain knowledge, some boys away from these institutions who would otherwise attend them. They buy the uniform simply to conform to the requirements and not for their own benefit. Under the system here proposed these students have very little, if any, use for their uniforms, as they do not wear them except on drill. Why should they be compelled to buy them any more than they are to buy their guns?

The Government appropriates $1,000,000 a year to the different States for the equipment of their militia. Why would it not be right, then, for it to appropriate a much smaller amount for the complete equipment of these cadet battalions? Is not the educated young man who takes a two years' course of training and makes an officer of this militia in time of war entitled to as much aid as the private in this same militia who, perhaps, only serves a few months? Experience everywhere goes to show that these Land-Grant and other civilian colleges are training the men who will defend the nation in the time of need. The Inspector General cites an instance in his report above referred to of one of the oldest colleges whose military department is said to have furnished from its alumni 12 general officers, 25 colonels, 40 field officers, and 198 company officers, a total of 275 commissioned officers for the civil war. During the recent "miners'" war in Tennessee we noted that nearly all of the commissioned officers in the State militia, many of whose companies were organized for the occasion, were the graduates of our Tennessee University. We have no doubt that every State institution can submit similar facts in support of this view.

Our great, rich country should not consider the expense of this business, if it is right to do it; but if we suppose that the additional equipment of each cadet can be made and delivered at the institution by the Government at a cost of $20 (which is more than the average cost of our uniforms, we presume), it will only cost the Government $240,000 to equip this entire army of 12,000 boys. One fourth of the amount apportioned among the States on account of the equipment of the militia would equip all of our present battalions handsomely.

On motion of Mr. Fairchild, the report of the chairman was referred to the Section on College Work for consideration.

The chairman of the Section on Entomology, Mr. Bruner, of Nebraska, was absent, and no report was made by that Section.

No report by the Section on Mechanic Arts.

The PRESIDENT. At the New Orleans convention a committee was appointed on the uniformity of numbering station publications. The purposes for which this committee was appointed were very forcibly brought out at the New Orleans convention. It was there stated, what we all know, that the station publications were very un-uniform and that there was a marked lack of symmetry in their make-up. This committee was appointed to see wherein these publications might be improved. Mr. Harris was appointed chairman of the committee and is here ready to report. I hope that this report will be carefully listened to by members of the Association.

Mr. Harris presented the following report:

REPORT ON UNIFORMITY OF STATION PUBLICATIONS.

The convention of the Association of American Agricultural Colleges and Experiment Stations, held at New Orleans, November, 1892, after a discussion of the inconvenience arising from the different methods of naming and designating bulletins in use by the experiment stations, appointed the undersigned as a committee to devise some uniform plan to be recommended to the stations. After due deliberation and consultation, we have the honor to present the following recommendations:

The publications of the experiment stations should consist of annual reports, bulletins, and circulars.

Annual reports should be numbered in regular order, and be designated by the year which they cover, as "First Annual Report, 1888," "Second Annual Report, 1889." The annual reports should be printed as separate publications, and should not be called bulletins or numbered as such.

All bulletins, with the possible exception of meteorological bulletins, should be included in one series, and should bear the natural numbers in regular order, preferably without volume or year numbers, but in connection with these, if necessary. They should always bear the date of publication on the title-page. This recommendation involves the abandonment of the use of letters or other peculiar means to designate "special". bulletins, or those which are not to be distributed to the whole list. In case bulletins are issued for limited circulation, a note should be included in the next bulletin for general distribution, stating the character of the omitted bulletin, and explaining why it was not sent to the whole mailing list. The words "new series," "second series," etc., should be omitted from the title-page of bulletins. They are not necessary, since the number of a bulletin with the date of issue will always be sufficient for identification.

Reports of meteorological data, issued very frequently, may constitute a separate series of bulletins, if desired, but the existence of this series should be explained in other bulletins by a note.

It will add to the convenience of those who use the reports and bulletins if the stations will use page headings, printing on the left pages the name of the station ("Illinois Experiment Station"), or the designation and year of the publication ("Second Annual Report, 1890"; Bulletin 27, 1891), or both ("Connecticut Experiment Station, Second Annual Report, 1890"); and on the right pages the subject treated ("Spraying of Fruit Trees"; "Fermentation of Tobacco").

Circulars should be used for inquiries or the publication of matter not requiring permanent record, and should never be made the sole repositories of matter of scientific or permanent value.

Newspaper bulletins should never be made the sole repositories of any information of permanent value.

The committee would call especial attention to remarks of Prof. S. W. Johnson on the preparation of bulletins and reports, which will appear in the proceedings of the New Orleans convention, and to the following resolution adopted at the Knoxville convention:

"(*a*) The bulletins to be uniform in size, 5¾ by 9 inches, and not to deviate from this measurement more than one quarter of an inch when trimmed. (*b*) The title-page to bear conspicuously the number of the bulletin, its date, the name and post-office address of the station, the subject presented, and very little besides. (*c*) The reverse of the title-page (or page 2) to carry upon it all other information desired to be conveyed by the bulletin, except its principal subject matter. (*d*) The annual report to be of the same size as the bulletins, if practicable."

Respectfully submitted.

A. W. Harris,
W. A. Henry,
A. A. Johnson,
S. W. Johnson,
R. J. Redding,
Committee.

Mr. Alvord. By direction of the executive committee I now move that this report be accepted, adopted, and referred to the new executive committee for publication and distribution, and that it also be incorporated in the proceedings of this convention.

Motion carried.

The President. Before the close of the session this morning it is suggested that we hear from Dr. True, of the Office of Experiment Stations, in regard to some matters of general interest to the stations concerning their relations to the Department of Agriculture at Washington. I have the pleasure of introducing Dr. True.

Mr. True. In view of the new relations which I have been called upon to sustain towards the Office of Experiment Stations I have desired to come in this way before the Association that I might look into the faces of the delegates and that I might say a few words regarding the work of the Office. While I have been connected with the Office from its organization my duties, as very many of you know, have been of such a character that I have had few opportunities of getting acquainted with those actually engaged in the work at the different colleges and stations. I, therefore, greatly prize this opportunity of standing before you and it will be an inspiration to me in my work.

The Office of Experiment Stations has now been in operation about five years, and its lines of work have developed as circumstances seemed to require. The chief aim has been to do that which would be of most service to the stations and most helpful to the cause in general. At the outset comparatively little was known regarding the needs of such work, and it has only been as we have come to understand what the needs of the stations really are that we have been able to put our

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Note.—Stations in the following named States are still using peculiar and undesirable means of naming and numbering publications: Alabama, Georgia, Louisiana, Maine, Maryland, North Carolina, Ohio, South Carolina, Tennessee, Virginia, and West Virginia.

work into definite form. It may be of interest to some of our visitors to know that the Office of Experiment Stations bears a twofold relation to the work of the experiment stations of this country. It is in the first place a branch of the Department of Agriculture, and a considerable portion of its work grows out of the peculiar relations which it sustains to that Department. For example, as a branch of the Department the Office of Experiment Stations must take its share of the daily mail that comes to the Department from all parts of the world, and, as it is one of our duties to collect information from the fifty or more experiment stations of this country which are making investigations on a great variety of problems, the general correspondence of the Office is very large and covers a wide range of subjects. We have other duties growing out of our relations to other divisions of the Department, and our work in general must be carried on under the conditions which exist in the Government service. This is true, for example, in regard to our publications, which must be issued through the Government Printing Office in regular order. We can not simply get up a publication and take the manuscript under our arm and walk into a printing office and make a bargain with the printer to get it out in twenty-four hours or a week, but the publication must go through the regular routine of the Department service.

The other side of our work, and the one to which I wish to call especial attention at this time, grows out of our relations to the colleges and stations. We take the reports of the investigations of the different stations and work them up in a condensed form for the use of other station workers; or we put certain portions of these reports into popular form for general distribution, so that people throughout the country may get information as to what is being done in the different States. Thus far the Office has expended its energies very largely in publishing documents which are primarily of interest to station workers and others engaged in investigations in agricultural science. Our principal publication, as most of you know, is the Experiment Station Record, which is issued monthly, and contains abstracts of station publications and of publications issued by similar institutions in foreign countries.

In another way we have tried to sum up the work of the stations and put it into the brief form of a card index. This enterprise is in some respects of a kind that has never before been undertaken, and we have met with unexpected difficulties, especially in the way of the publication of this work. The classification of the subjects with which agricultural science deals has never been undertaken before in the thorough way in which the Office has undertaken it. We think from what experience we have already had that we have made a reasonably good classification, and we hope that this index, which in manuscript form now covers all the past work of American stations, will be issued more rapidly, and that soon at least one copy will be found in every college and station library throughout the country, so that those who are interested in such studies may readily find the information they desire.

As some of you may know, Congress at its last session gave us authority to sell copies of this index at a cost to cover the additional expense involved in the preparation of the copies sold. The cards will be furnished at the rate of $2 per 1,000, and in addition to this there will be a charge of $1.25 for a set of division cards and blocks. We have issued now about 3,000 cards, so that the cost of a set of the index up to date will be $7.25.

In this informal talk concerning the Office I will mention one other feature of our work in a direction in which we hope hereafter to make greater development. We have been at work for some time in getting up a collection of station publications from the earliest ones down, and we believe that we now have as complete a set as there is in the country. This, as far as possible, we desire to make available to those who have no such collection, and beyond that we want to do a great deal more in the direction of library and bibliographical work. To that end we have secured recently the appointment of a man who will give his attention very largely to that work. The aim will be as far as possible to get acquainted with the literature of agricultural science, and especially with the earlier publications; to know where they are, whether in the library of the Department of Agriculture, the libraries of the different institutions, the Library of Congress at Washington, or elsewhere in the country; to know how they were published, where they may be obtained if still for sale, or how they may be loaned to those who desire to use them, so that the workers in our stations and colleges who desire to study up the literature on any one subject may go beyond the resources of their own libraries and have as far as possible at their command the resources of the libraries of this country which contain works on that subject. Of course this work will require a great deal of labor and can only be gradually performed.

In conclusion, I am glad to say that the prospect is that we will be able, without hindrance, to carry on and develop our work so as to make it more useful to the stations and colleges, and I trust that the same spirit which has pervaded the work of the Office in the past—I speak freely of this because I have had no responsibility for it—will be continued. We shall look with confidence for your coöperation and aid in the formulating and carrying out of plans by which we can make the Office of Experiment Stations more truly helpful to the great cause in which we are all so much interested.

I thank you for your kind attention to these informal remarks, for I had no thought of speaking just at this time, and had prepared no notes.

Mr. ALVORD. I think it desirable that as much business as possible be accomplished to-day, and as I understand from the chairman of the coöperative station exhibit that he is willing to present his report to-day, I suggest that he be requested to do so at this time.

Mr. ARMSBY. The committee on the coöperative station exhibit desires to submit to the executive committee a more full and complete report than it has been possible as yet to prepare. We therefore ask leave to present at this time a mere preliminary report and be permitted to file a more complete report with the new executive committee.

The PRESIDENT. I am sure that permission is granted. Proceed.

REPORT ON THE COLLECTIVE STATION EXHIBIT.

Your committee having made two previous reports of progress in which the nature and purpose of the collective station exhibit were described in detail, begs to submit, as the most essential part of its final report, the exhibit itself, located at column D, sec. L–3, in the Agricultural building.

While aware of its defects and conscious that we have by no means reached our ideal, we recognize that the exhibit is the ultimate measure of our success or failure, and we therefore submit it to the indulgent judgment of the Association without apology on the one hand or laudation on the other.

We desire to gratefully acknowledge: First, the very cordial support and coöperation of the several stations. Out of the 54 stations of the United States, 47 are represented in the exhibit, many of them by contributions which have cost much time, labor, and money. Nearly all those stations which did not contribute expressed an interest in the exhibit and regretted the circumstances which seemed to render it inexpedient or impossible for them to take part.

Second, we desire to acknowledge and to call the attention of the Association to the faithful services of those gentlemen who, at no little personal inconvenience and for no reward except the promotion of the general welfare, superintended the collection and installation of the several subdivisions of the exhibit.

Third, we feel that very special and grateful recognition is due the U. S. Department of Agriculture and its representatives, the Hon. Edwin Willits, Assistant Secretary, and Mr. A.W. Harris, Director of the Office of Experiment Stations, both for the very generous financial support, without which the undertaking would have been impossible, and for their personal interest and labors in its behalf. The installation of the exhibit, as well as its care, has been, in accordance with the original understanding, entirely under the charge of the Department and specifically of the Office of Experiment Stations. Your committee endeavored to render such aid as lay in its power, but the whole burden of responsibility and annoyance, inseparable from the installation of so large and complex an exhibit under the conditions prevailing during the early days of the Exposition, rested upon Mr. Harris and his assistants.

Fourth, we wish to record our appreciation of the hearty interest taken in the exhibit by the Hon. W. I. Buchanan, Chief of the Department of Agriculture of the Exposition, as shown in the generous assignment of space in the Agricultural Building and the many courtesies extended to the committee.

Respectfully submitted.

H. P. ARMSBY,
Chairman of Committee.

The PRESIDENT. Unless objection is made the committee will be continued.

Mr. ALVORD. Mr. President, I would remind the Association that the general exhibit of colleges and stations has been made in coöperation with the Department of Agriculture, and it seems to me well to have this connection maintained. I think, therefore, it would be well to hear from the Director of the Office of Experiment Stations as to whether reports on the laboratories can be made and filed with other reports, and published with them in the proceedings of the Association.

Mr. TRUE. I think that without doubt it will be feasible for the Office of Experiment Stations to prepare such a report and have it form a part of the proceedings of the Association.

[It has not been practicable to include the detailed report of the exhibit of colleges and stations in the present bulletin, but arrangements will be made for its publication later.—EDITORS.]

The PRESIDENT. The Bureau of Education of the Department of the Interior is represented here by Mr. J. W. Holcombe. We should be glad to hear from Mr. Holcombe regarding the relations of the Department of the Interior to the agricultural colleges.

Mr. HOLCOMBE. Mr. President and members of the Association: A year ago at this time I had the pleasure of being present at a convention of this Association at New Orleans as a visitor, representing informally the Secretary of the Interior and the Commissioner of Education. At that time it seemed good to the Association to provide that the Interior Department, through the Bureau of Education, should be regularly represented by a delegate, and it is my great pleasure to be present here to-day as a delegate for the first time from the Department of the Interior, and to express to the Association the appreciation of the Commissioner of Education and the Secretary of the Interior of your action at that time.

The relations of the Department of the Interior with this body came about through the act of Congress generally known as the Second Morrill Act, providing additional endowment for the agricultural colleges. The Secretary of the Interior was made by the law the administrator of that act, and by a departmental order this duty is assigned to the Bureau of Education. It may be interesting to the Association to know that all the States and Territories of this Union are now recipients of the benefits arising under this Second Morrill Act, except the Territory of Alaska, the Indian Territory, and the District of Columbia, and it is assumed that these political divisions are not entitled to its benefits without further legislation; at any rate, they have no institutions entitling them to any of this fund. The State of Montana has organized a college of agriculture and mechanic arts and received one installment last year, the year ending June 30, 1893, and that State, together with all the others, received the appropriation, at the beginning of the present fiscal year. I had the honor at the New Orleans convention to speak more formally about the reports of treasurers and presidents of colleges made through the Bureau of Education to the Secretaries of the Interior and Agriculture. You will remember that the act requires that reports of treasurers shall be submitted on or before September 1. This requirement has in most cases been complied with, a very few reports coming in after September 1. I refer now to the present year, September just passed, because previous to this time, owing to the inevitable delay in putting the law into effect and the difficulty, I suppose, of the different colleges preparing themselves to receive the fund, this requirement was not looked into very closely. But the language of the law seems to be mandatory that the treasurer's report should be submitted before September 1, and I take the liberty of calling attention to this, though it has not seemed necessary to the Commissioner of Education to notice that point up to this time; yet there is no telling how a requirement of that kind will be interpreted hereafter.

No date is mentioned in thelaw for the rendering of reports of presidents, and consequently the Commissioner has recommended the States and Territories to receive installments of the appropriation without regard to these reports, basing his action on the report of the treasurer. But I beg leave to say on the part of the Bureau of Education that it would greatly facilitate the work of the Bureau in tabulating general as well as financial statistics of the different institutions, to make a full and satisfactory comparative showing, if the presidents' reports could also be had before September 1 or very soon thereafter. Each bureau of the Department of the Interior makes an annual report of its work to the Secretary on September 1. The receipt of these reports at that date would afford the Commissioner of Education an opportunity to present at a very early date the work of these colleges for the year just closed. We could at that time make a complete tabular statement of the financial and general educational statistics of the institutions which could be distributed to all these institutions and to some extent among the educational officials of the country.

I thank you for your kind attention, and am very glad to be present in the Association again.

The PRESIDENT. Is there further business?

Mr. ALVORD. I would suggest that as to-morrow's meeting will probably be the last in general session, any resolutions which are to be offered should be submitted now in order to be acted upon by the executive committee.

Mr. TRUE. In the report of the executive committee attention is called to the exhibit of French agricultural schools and experiment stations. I think that there should be some expression of appreciation of this exhibit on the part of the Association, and therefore move that a special committee be appointed by the chair to consider what ought to be done in this and all similar cases, and report to the Association later.

The motion was carried.

Mr. KELLOGG. In conformity with the suggestion made in regard to the meeting to-morrow, I would like to present a resolution in regard to the method pursued by the Government in the distribution of seed.

Resolved, That it is the sense of this convention that the distribution of plants and seeds should be put into the hands of the agricultural colleges of the States and Territories.

This resolution was, under the rules, referred to the executive committee.

Mr. FAIRCHILD. I would like to offer a suggestion as to station notes given in the Experiment Station Record. It seems to me that the stations doing the least make the most reports, for the reason, I suppose, that they have plenty of time for it. Is it not possible to make the form of request for information more explicit, to so formulate it that every station will have to report certain data each month, showing what is going on at the station? As it is now it is a matter of judgment whether anything is worth reporting when compared with the many things undertaken. It seems to me that the Experiment Station Record would be worth more if there was a report of progress from each station.

Mr. TRUE. The Office of Experiment Stations desires to publish in the Record any item of news which is of interest to college and station workers, and would be glad to receive news from any and all college and station officers.

Mr. WELBORN. I submit the following resolution:

Resolved, That it is the sense of this Association that Congress should provide uniforms and other military equipment for the cadets at the Agricultural colleges.

Mr. DABNEY. I suggest that this resolution be referred to the Section on College Work, which has this subject under consideration.

The PRESIDENT. Unless there is objection the resolution will be so referred.

Mr. MORROW. I wish to call attention to the fact that the evening session will probably be held in the hall adjacent. It is to be, formally, a joint session of this Association and the Section on Agricultural Education and Experiment. President Henry will deliver his annual address and we confidently expect that Sir Henry Gilbert, of the Rothamsted Experiment Station, will arrive during the afternoon and will be here to deliver his address. President Fairchild, of Kansas, will deliver an address on intellectual development in agricultural education.

On page 33 of the general program of the Agricultural Congress you will find the one of interest to this Association. I wish to call especial attention to the program for Friday afternoon, which will be devoted to agricultural features of the Exposition, more especially the dairy test. Papers will be presented by Profs. Armsby, Roberts, and Scovell. Dr. Babcock will give the history of the methods of work and some of the results, and Prof. Farrington the laboratory features, of the test.

Chief Buchanan will present a paper on the agricultural features of the Exposition in general.

I may state that after consulting with the authorities, I am able to announce unofficially that the Section on Education and Experiment of the World's Agricultural Congress will meet to-morrow afternoon at 2 o'clock, instead of at 10, as stated in the program, and thus avoid conflict with the program of this Association.

The meeting adjourned at 12:30 p. m.

AFTERNOON SESSION, TUESDAY, OCTOBER 17.

The joint session of the Association with the Section on Agricultural Education and Experiment of the World's Agricultural Congress was called to order by Chairman Morrow at 2:10 p. m.

The following papers were presented:

Agricultural Education in France, Leon Vassilliere, agricultural commissioner from France.

Agricultural Education in Russia, Peter R. Slieskin, professor in Agricultural Academy, Moscow, Russia.

The Agricultural Societies and other Agricultural Forces of Belgium, Paul DeVuyst, agricultural inspector, Belgium.

The Relations of the General Government to Agricultural Experiment Stations, A. W. Harris, president Maine State College, late director Office of Experiment Stations, U. S. Department of Agriculture.

Agricultural Education in Germany, Dr. A. Backhaus, Berlin.

Agricultural Education in Japan, T. Menami, professor of agriculture, Imperial College of Agriculture, Japan.

EVENING SESSION, TUESDAY, OCTOBER 17, 1893.

The meeting was called to order by Chairman Morrow of the Section on Agricultural Education and Experiment of the Agricultural Congress.

President W. A. Henry was introduced and delivered his annual address.

PRESIDENT'S ADDRESS.

In previous gatherings of this Association your presiding officer, always having been chosen from the college side of the organization, has naturally dwelt largely on the educational features of our work. Representing the station side more particularly, it seems eminently proper that on this occasion I should direct your attention to matters which relate to experiment stations, their organization and work.

The gift of the General Government to each of the several States of the Union of $15,000 annually for agricultural investigation stands without a parallel in any other country in its liberality toward agriculture, and is surpassed in this only by that other gift to agriculture whereby in one act there was ceded to the several States some 11,000,000 acres of land for founding agricultural and mechanical colleges. When the history of our American experiment stations is written, it will be found that the relations of our stations and agricultural colleges are so intimately interwoven that an account of the one will be incomplete without the history of the other.

When the grant of 1862 was made, there was little besides theory in regard to agricultural education in this country, and from the president of the board of trustees down to the lowest instructor there seemed to have been only the crudest ideas in relation to the proper method of procedure. As in every case where there is no clear conception of the work in hand in advance of its inception, many mistakes were made in the organization of these institutions, some serious, yet in a majority of cases all will work out well. As I review the situation it seems to me that our experiment stations have made fewer mistakes, and as a consequence have attained far greater success in the short period of their history than did our agricultural colleges in a like length of time. And the explanation of this is easily within our finding. Our colleges, originating in the act of 1862, had but a single example of an agricultural college in this country, and but little was known of those in the old world. With our experiment stations the case was quite different. Some of the German stations had been in existence for a generation, and had accomplished much for the development of agricultural science. Then there was Rothamsted, that ideal station, the work of which is more or less known and appreciated by every intelligent American farmer, and whose reports are regarded by all investigators and teachers in science as agricultural classics. This station had been working for forty years, and its light had shone clear round the world. In our own country the Department of Agriculture at Washington, in some of its divisions, had been conducting most fruitful investigations, not only greatly aiding American agriculture, but, what was equally important, had been training men to this very line of work. Several of our States had already established experiment stations, and some of them were making excellent reputations. The very growth and struggles of our agricultural colleges had accomplished much toward breaking the way for our stations.

In some fair measure, then, times were ripe for the coming of the stations; still, as I look back, it seems to me the act was too general, and too sudden for the greatest good to be derived from the expenditure. The report of the Secretary of Agriculture for 1892 shows that there are now nearly 500 workers in our various stations. In calling to this work in a single year hundreds of men it was impossible that all should be properly trained for the work, and many of those selected were not fitted for it either by training or by natural adaptation, and as a consequence there has been much shifting and replacing, the end of which I fear is even yet not reached. I believe it would have been far better for the reputation of both our agricultural colleges and our experiment stations had the acts establishing them contemplated a progressive gradual movement. This might have been accomplished by coupling conditions with the grant making it obligatory, for example, that each State, in order to receive Government aid, must show its earnest by placing a liberal sum with that given by the Government. This would not only have insured a larger income to the institutions when established, but would have caused each State to regard the matter seriously before taking the initial step. In consequence, probably but a portion would have availed themselves of the act at first, and, this true, these pioneer colleges and stations would have proved the training ground for teachers and investigators for those institutions organized at later periods.

It is now about six years since the passage of the Hatch Act, yet in that brief space of time more than forty stations have been organized and, with all the mistakes, many now have on record investigations creditable to scientific effort and the cause they represent and a few have made a marked success. If you ask me to point out some of the successful efforts of our stations, let me refer you to the great work done in regulating the manufacture and sale of commercial fertilizers in the Atlantic and Gulf States. Without the closest regulations and the protection of law, there is no material in trade where fraud is so easily perpetrated, and where deception is so difficult of detection, as with commercial fertilizers. Our experiment stations have not only done much in developing methods of analysis by which the qualities of fertilizers are made known, but they have secured the placing of laws on the statute books to regulate the guaranty and sale of fertilizers, until now more than $30,000,000 worth of this material is annually bought by farmers in a business-like way, no purchaser being ignorant of what he is securing unless he is blind to the facts laid before him by the stations. Then, too, the study of the effect of these fertilizers upon the growth of crops has been very helpful.

The subject of economic entomology serves another excellent illustration. The Department of Agriculture at Washington early recognized the importance of this branch and the large opportunity it presented for helping agriculture, and here and in a few of our leading colleges and stations there has grown up probably the best corps of agricultural scientific workers we can point out in this country, excepting only the agricultural chemists.

A number of our stations are spending much effort in a study of the Indian corn plant, and already great good has been wrought in the knowledge of how the nutrients are elaborated by the growing plant constantly increasing in amount until the very closing days of its life. Then, too, the work in showing the large amount of nutrients in the cornstalk, aside from the ear, has been worth untold good to our farmers, and is working a small revolution in agriculture in the corn belt.

At the South the sugar-cane investigations and the introduction of new forage plants have been of great help to the planters, who have in a most marked way shown their appreciation of what has been accomplished for them. The waste of cotton seed by the Southern planter for generations and until very recent times is perhaps the most marked example we can point out of the enormous cost of ignorance. Southern stations have shown that in the cotton seed, cotton-seed meal, and cotton-seed hulls there is nutritive material in the highest concentration sufficient to feed hundreds of thousands of cattle where there was only waste before.

The dairy industry, one of the greatest in agriculture, is now undergoing remarkable revolution, which was started by scientific men on the other side of the water, and has been caught up by our own investigators in America, and untold good has been accomplished. No line of agriculture is so rapidly being placed on a scientific basis as is dairying. In all this progress our stations hold an honored position.

Lack of time prevents my calling attention to other work accomplished, but there is one instance that I can not forego calling to your mind. So general has become the interest in agricultural investigation that our World's Fair directors, in planning this colossal exposition, could not escape the impulse, and so here, right in Jackson Park, during all the coming and going, hurrying and sight-seeing, there has been conducted the most remarkable dairy investigation ever undertaken. All honor to Chief Buchanan and the directors who stood by him in his worthy work of rounding out the great agricultural branch of the Exposition with a genuine scientific agricultural investigation! When, as members of this Association, you have come to comprehend the scope and value of the dairy test now closing, and measure its help to that great industry, you will begin to appreciate what a vote of confidence was awarded us by the directors of the Exposition when last November, at New Orleans, they asked this Association to appoint from its members experts, who, in conducting this test, should not only hold the balance of power, but be the main source of direction and control in this great experiment.

If you ask for still further evidence of appreciation, I can point you to the data in the last report of the Secretary of Agriculture, which gives the revenue of the stations for 1892. You will there note that for the support of experiment stations the General Government gave aid to the amount of $689,000 in round numbers. The individual States supplemented this sum by the very large amount of $152,000, while local communities added $85,000, and individuals over $1,000. In other words, States, local communities, and individuals gave over one third as much as the General Government in financial aid to our stations, and the proportion given by the States is rapidly increasing. Surely there must be some appreciation of the work we are doing to have called forth such generous aid from those who, best of all, are in position to measure what we are accomplishing.

One reason that every earnest, faithful, working experiment station has a strong hold on the agricultural people is because its workers have met the farmers at the institutes and farmers' club meetings for frequent conference, and have given instruction through the agricultural papers, acting in no small degree as teachers and counselors. It is true that when a station worker is on the institute platform or addressing a farmers' club, he is not investigating, and when he is writing for the agricultural press he is not doing laboratory work, but the call for help from our farmers has been so great, and so marked their appreciation, that it has been impossible to escape it. With earnestness on both sides and a desire to give and receive help, the most cordial and close relations now exist in a number of our States between the experiment stations and the intelligent farming people. To be frank with you, I believe that our station workers have in many cases accomplished more good for the cause of advanced agriculture through their efforts at instruction than through all they may have discovered.

Nor is this anything but natural when we study the subject carefully. The investigators of Europe had discovered and accumulated a large amount of material of great value to agriculture. Little of what they had done had been explained and made known to the great mass of farming people in the days before the establishment of our stations. Finding this rich material available to our people for the presentation, it is not the least surprising that our station workers have made good use of it in many ways. It is as though we had found gold mined by workers in the Old World which we could have for the asking; we have taken this gold to our American farmers, and in giving it we have not only received thanks from them, but, what is more important, we have gained their confidence in our assertion that there is much that can be discovered in agriculture that will be helpful to them.

The more I study the work of our experiment stations, the more I am pleased with what we have accomplished, and the larger grows my faith in the high position they are destined to occupy in American agriculture.

Trusting that I have left in your mind no uncertainty of my position on this point, let me turn your thoughts now to some of the errors I believe we have made in the management and direction of our stations in the pioneer days of their history, now closing. I admit our stations, one and all, have made some serious mistakes, but I believe they have been of the judgment and not of the heart.

If we study the reports and bulletins as they come to our tables, I think we must all confess that many of the so-called experiments and tests reported show marked faults. Very frequently there is apparently little careful planning and that preparation so essential to good scientific work. With the preliminary work slighted, it is not surprising that other evils follow. Often the figures given in the report are inaccurate on the very face of them, showing errors in simple addition and multiplication; sometimes the proof-reading is careless and the explanation of the work ambiguous and faulty. All of this leads to the suspicion that back of the report were slovenly methods and lack of care in keeping records.

Another error into which many of us have fallen is the lack of continuity. An interesting investigation appears in some bulletin or annual report; the author has taken up his subject in good shape and his investigations are interesting and show a profitable line of experimentation. When later reports come to us, we open them hoping to find additional work on the subject before discussed, but often it is lacking, and the investigation seems to have been dropped for some new line. I here venture the assertion that there has not been a single investigation undertaken by any one of our stations and carried on faithfully for a series of years that has not brought forth good returns for all the capital, mind, and money that has been put in it.

One reason for the lack of continuity is the numerous changes in the personnel of most of our stations. Unfortunately our workers have been shifting about, many dropping out to be replaced by new ones, while others go from one station to another, and in almost every case where a change is made, the work in progress is dropped for something new. Again, changes are frequently made by direction of those in authority. Boards of trustees are constantly changing their membership, and each incoming member is apt to be fired with a burning zeal to distinguish his entry into office by some striking innovation. Here is an excellent opportunity for tact on the part of the director; let him begin the work of educating his board at once, and impress upon them the necessity that each one first understand the situation before advice and counsel looking to changes are given. In illustration of this let me point to a case which occurred at the Wisconsin Station. A certain new member of the board, one who is an ardent admirer of the trotting horse and horseflesh in general, was placed on the station committee. Now, for reasons which seem proper to me, we have never undertaken work with horses at our station, and I assure you that my fears were great when I was told by friends that our enthusiastic trustee would soon have a race course on our station grounds as well as a stable of fine trotters. I have no doubt but his first inspection of our live stock filled him with disgust, and he mentally resolved on some marked changes. But he was a sensible man, fearing radical changes, and willing to study the situation. The result is that for two years I have had the most cordial support from this trustee, lover of horseflesh though he still is, and to-day at our station we have not a horse that can trot a mile in less than five minutes.

But there are often more earnest and importunate advisers to the director than his trustees. There is hardly a man in this country, be he lawyer, doctor, or of any other calling, who has not a weakness for some special line in agriculture or horticulture. And so all classes of people are interested in our station work. Sometime since a lawyer in our State wrote to the president of our board stating that the influence of the moon on vegetation had never been properly studied; that it was a fact that some of those who believed in the moon theory were among the best farmers in the country, and he hoped that our board would at once direct the establishment of a line of investigation which should study this important and burning question. Only a couple of weeks since a letter came to the station from an intelligent citizen saying that he had as yet found nothing in our reports regarding mushroom culture, a subject in which he was deeply interested, and that he hoped to see the Wisconsin Station soon a leader in this work. Not only have we many counselors and advisers from outside our stations, but there is no lack of this form of assistance from within. Many of our workers are young men, with fertile brains and an eagerness to drop the old and take up the new, rather than plod on year after year in some treadmill line. If we are to do better work in the future we must not only work more carefully and more thoroughly, but we must more completely carry out each line that is undertaken before beginning anything new.

If the suggestions just made are to be carried out generally, we must cut down the lines of work we are endeavoring to carry, for many of us are attempting to cover too large a field with the force and means at our command. There must be a greater division of labor among our several stations, and each must be content to leave to others certain lines of investigation, much as we should like to carry them on ourselves. To show that I am trying to follow in some fair measure what I am advocating, let me call your attention to what some of you have noted, perhaps with surprise, as you have looked over the list of our station workers. At the Wisconsin Station we have neither botanist, entomologist, nor veterinarian at this time. When laying out the work it seemed to me that economic entomology was already quite well cared for by the excellent corps of workers in the Department of Agriculture at Washington and the men of marked ability in several of our stations. In order to put our work in entomology equally creditable with the best of other stations, there must be an outlay of several thousand dollars a year, and I believed that we had better use this money in some other line and let the farmers and horticulturists of Wisconsin get their information regarding insects and insecticides from these other sources. By thus saving and concentrating we now have at our station four employés who give almost the whole of their time to the single line of dairy investigation. I believe we are a stronger station by having four men in the single line of dairying than had we four working in four different fields. State lines count for but little in this country. The Babcock milk test worked out in Wisconsin is as helpful to an Iowa dairyman as to one living in Wisconsin. Prof. Roberts's work at Cornell on the great waste of barnyard manure through leaching in the open barnyard is as instructive to an Ohio farmer as though it were performed by his own station.

In endeavoring to strengthen our work we must allow a large sum for maintenance and equipment after providing for salaries. In looking over the reports of some of our stations I am surprised at the small amount of funds left after the salaries are paid. I do not see how the workers in such stations can be content, for surely they can not always have the proper apparatus to work with.

Another fault has been the lack of coöperation. We have talked about it in our annual gatherings, but have made little progress. I still feel that, though we have accomplished little, we should continue to look toward a more general and hearty coöperation among those stations pursuing kindred lines of investigation. Why can not those stations which are conducting experiments in dairying confer together in regard to the work in hand, and agree that some parts of it at least should run along the same lines? Why can not stations which are endeavoring to determine the effect of distance of planting on the yield of corn have some things in common in their work? And so on with many other lines. There should be no coercion, and I would have our workers drawn together in their coöperative efforts by natural affinities rather than by positive direction from this or any other body. Whether or not we work together, I have no fears of the useless duplication of work. That was talked of in the first meeting of this Association, but of late we hear nothing regarding it. If we had more duplication we might be more assured of the correctness of some of the results announced.

One more point where it seems to me our stations must improve, and I am done. Should there not be a clearer demarcation between the duties of teacher and investigator in our colleges and stations, and has not our work suffered in the past because of the poor definition which now exists? Our agricultural colleges are the older institutions, and in a generation they have developed a goodly number of able teachers; the stations coming last, and having been added to, the colleges, it has followed quite naturally that in manning them the workers were drawn largely from the teaching force. In a number of cases we find that the president of the college is director of the station, and that each of the divisions of investigation is assigned to a college professor. First of all, how can the president properly do double duty as executive officer of the college and director of the station? The successful president of a modern college represents a combination of more attainments than is required in any of the learned professions, and nowhere is there a harder-worked man. He is a diplomat in his dealings with the State officials on the one hand and no less so while daily attending to petty matters of discipline among the hundreds of pupils under his charge. He is a financier of marked ability in ever watching to increase the income of his institution from every possible source, while yet closely supervising and guarding every expenditure, no matter how small. Besides the accomplishments of diplomat, financier, and guardian of hundreds of young lives he must withal be scholarly, and with voice and pen wait the beck and call of numerous organizations throughout the State. With all this and still other duties, let me ask you, how can a man give proper attention and direction to scientific investigation? As well might some railroad magnate let his ambition carry him to the belief that he could serve as president, general manager, head counselor, and division superintendent of a great railway system.

Nor is the situation markedly better in the case of a hard-worked professor. Our colleges expect not less than three lectures or recitations daily, and often much additional instruction is placed upon them. When the station comes in for consideration these authorities seem to hold that after the teacher has spent three or more hours in the stuffy class room he may just as well devote the remaining hours of daylight to refreshing himself by good, vigorous work as an investigator, since, the two lines being so different, one must prove a recreation from the duties of the other. In a spirit of generosity the authorities sometimes drop an hour a day from the work of a professor that he may have an abundance of time for his investigations, and even agree that he shall have assistants to carry out the details of the work, leaving only the planning and general supervision.

Now, it generally turns out that these assistants are recent graduates, who gladly accept the positions as stepping-stones to something better; often they are undergraduates eager to earn a few dollars to help pay their way. I believe such a combination as this is most unfortunate for the college, because it is harmful to the station which is associated with it. No man, however able, is properly prepared to do any considerable amount of class-room work and then conduct investigations of the grade that our experiment stations must call for in the future. But it is said that these men are not asked to actually do much of the work, but only supervise it. I ask you, how can high-grade investigative work be carried on through subordinates of the class usually given to teachers as helpers in such cases as this? As I understand it, investigation requires in some measure the same play of faculties as does invention; what inventor would be willing to devote his best energies each day to some other line of work, and in lieu of his own powers thus diverted, substitute the work and observation of novices? If we are to secure the highest result from our station work, our investigators must be put just as close to their subjects matter as is possible and they must stay there from first to last. The investigator who is experimenting with steers or swine must keep close to his animals every day of the trial, not a mere looker-on, but a most careful observer and recorder of every action and every development. He who has growing plants under his charge must stay close with them from the time the seed is put into the ground until the harvest is over and the analyses completed. The teacher who spends his time in the class room or at his desk and turns over the care of his animals or his growing crops to subordinates is sure to lose that living connection which must hold between worker and the objects investigated if there is to be any real scientific advancement. You might equally well have come to this great Columbian Exposition by proxy. You could readily have secured a young man for a dollar or two a day and expenses who would come here and tramp through these buildings faithfully week after week and send to you a carefully written record of his observations. But you would not have seen the Fair, nor can any man who wishes to get down to the marrow of an experiment do so by any other means than by giving himself up to that experiment, soul and body, from start to finish. But it will be said in extenuation of the system that our teachers are brainy men and have lots of work in them. So they have, but they are generally worked down pretty well in the class room. There was once a blacksmith in this country who, while pounding iron, by great industry and persistency, and aided by a wonderful memory, became the master of fifty languages. He was called the learned blacksmith. There has been but one learned blacksmith in America, while each day at evening thousands of blacksmiths who have pounded iron all day go home to their families with tired muscles, in no fit condition for a tussle with roots and conjugation. Here and there there may be a professor who can pound iron in the class room all day and write learned books or conduct deep investigations during his spare hours, but they are about as rare as learned blacksmiths.

Nor need our colleges suffer seriously by putting the strongest men at the head as investigators. All studies that have much drill work in them—and three fourths of college work is steady drill—are taught in our leading institutions by instructors and assistants. If we can not have men of first grade in both station and college, let us have them in the station and let us turn over our general instruction to the assistants. These assistants can do excellent work in all the ordinary routine of teaching, such as chemistry, physics, botany, horticulture, veterinary science, and all the other branches common to agricultural colleges. Of course I would have strong men in both places were it possible, but I refer to cases where we are unable to reach this high result. Thus you see my idea is to put the station ahead of the agricultural college in the grade of men employed provided both can not be of first rank.

But I would use our investigators for teachers, bringing the students to them for the final polish—for rounding out the subjects under consideration—after each has had thorough drill under the best assistants the means would provide. The investigators being the strongest men in the institution, were we to bring a class to them one hour a day for one term in the year, they would impart instruction of the highest possible grade. And the student, brought in contact with such men in the closing days of his college life, would receive an impulse and gain a grasp of agriculture in its scientific phases that is impossible to impart to him in any other way. Drilling a student day after day in the elements he must master in order to attain the higher lines of the study requires one kind of teaching; to inspire him to a broad comprehension and a worthy grasp of the subject calls for another kind of teacher, and that teacher above all others is he who comes to the class room fresh from his field of investigation with mind loaded down with the information he has been acquiring and full of enthusiasm for his chosen subject. Under this system we can secure the highest sort of investigation in our stations, while the young men as they leave the college will carry an inspiration and an ideal with them that can be gained in no other way.

I believe the combination system which I have been deprecating is only another of those incidents of pioneer effort. It has been practically out of the question in many cases to find suitable persons for manning the station, and very wisely the college authorities have kept the direction of the station in the hands of the president and used the teachers as best they could for investigators. Under this system some excellent work has been done; indeed, some of the very best that has been sent out has come where this combination is practiced, but in such cases the good work has come from our very strongest institutions, those that from their very nature should prove leaders. I believe the time is not far distant when such institutions will adopt the division of labor somewhat after the method I have mapped out.

In all that has been said I have tried to convey the impression that our work as station investigators is even yet in its pioneer stage, and as a consequence there is much that is necessarily crude and irregular. Conceding that we have all made mistakes, I maintain, as was stated in the beginning, that they are errors of the judgment and not of the heart. I believe that almost without exception our station workers are honest in their efforts and earnest in their desire for the upbuilding of agricultural science. But as I look over the field I am deeply impressed with the fact that our work does not yet compare favorably in many cases with that of the older stations of Europe. These shortcomings and mistakes are incident to pioneer effort, and for the most part could not have been avoided. Let us study more carefully than ever before the work of those great institutions of Europe, using them as models whenever we can to help us on. Let us draw our work closer together, undertaking less, laboring more faithfully and more persistently. Let us grow out of amateur efforts into the true scientific spirit. Already we have gained a strong hold on our people and most cordially are they upholding us in our efforts. May each year see the cause strengthened until our stations shall become an integral portion of our agricultural system, and recognized leaders in all agricultural thought.

President Henry then took the chair and in a few well-chosen words introduced Sir Henry Gilbert, of England, to deliver an introduction to six lectures to be given by him in this country on the work of the Rothamsted Experiment Station covering a period of fifty years.

Mr. GILBERT. Mr. President and gentlemen: I thank you for the kind observations which you have made and the kind way in which they have been received. I have to acknowledge this kindness, not only on my own part, but in behalf of Sir John Lawes. You know—I think he has given you evidence enough of it—that he takes the greatest possible interest in the progress of agriculture, both practical and scientific, on this great continent; and as for myself, those of you whom I met on my two visits to this country know that I spent my time in making myself acquainted with the agriculture of the country and in making the acquaintance of my fellow workers on this side. I will not say that my interest is second to that of Sir John in what is going on among you, and I must say that I have been extremely interested in the remarks of your president, and that I entirely and heartily agree with him in his observations as to the impossibility of uniting active teaching with work of investigation except in a general way. Sir John Lawes and myself have so strongly felt this from the beginning that when asked to allow students to come to Rothamsted it has always been refused; and Sir John has made especial provision that the work of investigation shall be continued and that no part of the fund donated shall be devoted to educational purposes.

You will ask, perhaps, why is it, then, that I went to Oxford as professor for six years. It was simply because in no other way would it have been possible to have presented a great amount of results of investigation at Rothamsted; so I undertook to give lectures at Oxford to bring into form results that would otherwise have been left until now. So that is perfectly consistent with our views of not mixing the work of investigation and education. While I say that we always refused to take pupils at Rothamsted, we said you are perfectly welcome to come and read with others. We will give you no systematic instruction, but if you can learn anything we shall be very glad indeed to let you have the records; and so it is that we have had no systematic teaching, and we believe that if we should have had our investigations would not be where they are now.

Gentlemen, as you know, I have come to this country to deliver somewhere a course of six lectures, giving a résumé of the work covered at Rothamsted for the last fifty years. If you will allow me now I will read an introduction to those lectures.

Agricultural Investigations at Rothamsted, England.

[Introduction to six lectures on the agricultural investigations conducted for a period of fifty years at Rothamsted, England; delivered under the provisions of the Lawes Agricultural Trust, by Sir Joseph Henry Gilbert, M. A., PH. D., LL. D., F. R. S., V. P. C. S., etc.]

As you are doubtless all aware, it is under the auspices of the Lawes Agricultural Trust, which provides for the periodical delivery in the United States of a course of lectures on the Rothamsted investigations, that I appear before you to-day. Had the occasion been an ordinary one it would not be expected that at the age of 76 I should undertake the risks of so long a journey and the responsibility of delivering a course of lectures before this Association of Agricultural Colleges and Experiment Stations. But the occasion is not an ordinary one. Thus, the more systematic experiments at Rothamsted were commenced in 1843, so that the present year, 1893, is the fiftieth of their continuance; and it was considered desirable that under these circumstances something in the way of a general review of the half century's work and results should be brought before you. Obviously, the execution of such a task could only be appropriately undertaken either by Sir John Lawes or by myself, who alone have worked together from the commencement to the conclusion of the fifty years. Sir John Lawes is, however, even more heavily handicapped by age than I am myself, and at the earnest desire both of Sir John and of the trust committee I have accepted the responsibility.

I need not go into much detail as to the origin, scope, and plan of the Rothamsted investigations. These points were pretty fully considered by Mr. Warington in his first lecture in 1891, and a good deal of information on the subject will be found in the early pages of the now annually issued "Memoranda of the Origin, Plan, and Results of the Field and other Experiments, conducted on the Farm and in the Laboratory at Rothamsted." Indeed, I am sure you will readily understand that it is no easy task to compress within the limits of half a dozen lectures anything like an adequate account of the labors of a gradually increasing staff of workers over a period of fifty years. This must be fully recognized when it is borne in mind that the reports and other papers on the results at present number about 120, and that they occupy nearly 4,000 octavo and more than 800 quarto pages. These publications, moreover, brought together as they have been into bound volumes for the purpose of distribution in a collective form, make up 6 octavos and 3 quartos, while papers since published are accumulating toward another volume. A few years ago 50 sets of the 9 volumes were prepared, requiring the reprinting of nearly 500 octavo pages and the purchase of a good deal of the quarto matter. As many of you are aware, a number of these complete sets of 9 volumes each—I believe 26 sets in all—were presented by Sir John Lawes to as many educational and experimental institutions in the United States, and I am authorized by Sir John to say that he hopes to be able to send perhaps about an equal number more before or about the middle of next year (1894). In all 125 sets, involving the reprinting of about 1,100 pages octavo, and about 370 pages quarto, are now in course of preparation. Of these our own board of agriculture takes 50 to distribute to various institutions in the United Kingdom. There will then be left only 75 sets for distribution by Sir John Lawes himself to our colonies and to foreign countries, including those still to be sent to the United States. It may be added that to provide any more sets than those now in preparation would necessitate further reprinting almost in proportion to the number required; and when it is considered how much time must be expended in the revision of the reprints and how great the cost, little surprise can be felt at the delay in the completion of the work and the necessary limitation of the number to be provided.

Unfortunately, however, besides all the published matter, there still remain large arrears of as yet unpublished results. It is from this mass of material, published and unpublished, that I have to make my selection in endeavoring to give such a view of the objects and results of the Rothamsted investigations as may be of value, both as illustrating the advance in knowledge already attained and as indicating points for future inquiry.

Obviously the scheme proposed precludes the idea of going into much detail on any one subject, and supposes rather a comprehensive, but at the same time only outline, view of the whole. The next question is, whether the illustrations relied upon should have reference primarily to results obtained in the field and in the feeding shed, or chiefly to those of laboratory investigations. Now, as a prominent characteristic of the Rothamsted work has certainly been the devotion of great attention to both field and feeding experiments; and as by far the greater part of the laboratory investigations, whether chemical or botanical, have had for their object the solution of problems suggested by the field and feeding results, it has been thought that the most appropriate, and at the same time the most useful plan, will be to give a comprehensive view of the plan and results of the field and feeding experiments themselves, and to enforce the lessons which they teach, by such reference to laboratory results as the questions raised require for their elucidation, and as space and time will permit. In other words, the analytical and other laboratory work must be treated as essential means to an important end, and can not, within the limits of such a review, be made the subject of critical consideration as such. And here it should be observed that nothing is done at Rothamsted, in the way of manure or feeding-stuff analysis or seed control, for any purposes external to those of the investigation.

True it is, that although, as has been said, a large amount of field, feeding, and analytical results remains as yet unpublished, yet fortunately a much larger amount has already been put on record. Hence, it may be that some of those before me who are well acquainted with what has been written will be disposed to say as I proceed that we knew much of this before. On the other hand, probably a larger number of those present are not so well acquainted with what has been written, and a still larger proportion of those who may read these lectures afterwards may feel that the outline only which I can give will serve the useful purpose of assisting them the more effectively to study the fuller published records. Indeed, the object I have had in view throughout has been to afford guidance for further study rather than to attempt the impossible task of giving anything like an adequate account of the results that have been obtained or of specifically indicating lines of inquiry for the future.

It will be appropriate here to explain that, meeting Prof. Atwater two years ago in Germany, he urged the desirability of our sending to the World's Columbian Exposition pretty full illustrations of the Rothamsted work and results, to be exhibited side by side with those to be sent by the agricultural colleges and experiment stations of the United States; and that, on his way home some months afterwards, he paid a visit to Rothamsted, further to urge the plan on Sir John Lawes. A general assent to the proposition having been given, the question arose as to what sort of illustrations should be sent. Finally it was considered desirable to send such a series of exhibits as would serve to some extent as a substitute in case I were not able to visit Chicago on the present occasion; and which, in case I were able to give the proposed course of lectures, would be of service both to myself and to my hearers, in illustration of the facts and arguments I should have to adduce. Accordingly, it will be found that a large proportion of the 44 exhibits that have been sent have for their object the presentation to view of the results of the field experiments, of the nitrogen statistics of some of the crops, of the results of experiments on the question of the fixation of free nitrogen, and of results relating to the amount and to the composition of rain, and of land drainage. There are also plans of the experimental fields, showing their areas and the arrangement of the plots. Unfortunately, there is only one illustration relating to experiments on the feeding of animals. It was, however, intended that a pretty complete series relating to that most important subject should be prepared; but the enormous amount of time occupied and the great hindrance to other work involved in the preparation of the exhibits that have been sent rendered it impossible to complete the original design. Some of the omissions in the execution of the intended list of exhibits will, however, be made good by illustrations embodied in my lectures.

With regard to the amount of the exhibits which have actually been sent, it may be observed that the quantity of wall space originally asked for was from 3,000 to 4,000 square feet; but the area actually covered is 4,786 square feet. To put the thing in another way, 4,000 square feet corresponds to a quarter of a mile in length, a yard high; and the actual space covered (4,786 square feet) corresponds to rather more than three tenths of a mile a yard high; and yet, as above stated, the original design has not been fully carried out.

As a preliminary to any detailed explanation of the scheme of the lectures I propose to bring before you, it will be convenient to call attention to the general arrangement of the field experiments, and also to their extent and duration, as shown in the following table (I), which is No. 29 in the list of exhibits:

TABLE I.—*List of the Rothamsted field experiments.*

	Commencing.	Number of years.	Area, acres.	Number of plats.
Wheat (various manures)	1843–'44	50	11	34 (or 37)
Wheat (alternated with fallow)	1851	43	1	2
Wheat (varieties)	1867–'68	15	4–8	about 20
Barley (various manures)	1852	42	4¼	29
Oats (various manures)	1869	[1] 10	0¾	6
Beans (various manures)	1847	[2] 32	1¼	10
Beans (various manures)	1852	[3] 27	1	5
Beans (alternated with wheat)	1851	[4] 28	1	10
Clover (various manures)	1848–'49	[5] 29	3	18
Various leguminous plants	1878	16	3	18
Turnips (various manures)	1843	[6] 28	8	40
Sugar beets (various manures)	1870	5	8	41
Mangel-wurzels (various manures)	1876	18	8	41
Total	....	....	56¼	277
Potatoes (various manures)	1876	18	2	10
Rotation (various manures)	1848	46	3	12
Permanent grass (various manures)	1856	38	7	22

[1] Including one year fallow.

[2] Including one year wheat and five years fallow.

[3] Including four years fallow.

[4] Including two years fallow.

[5] Clover, twelve times sown (first in 1848); only 8 crops, 4 very small; one year wheat, five years barley, twelve years fallow.

[6] Including barley without manure three years, 1853–'55.

The general scope and plan of the field experiments has been to grow some of the most important crops of rotation, each separately, year after year, for many years in succession on the same land, without manure, with farmyard manure, and with a great variety of chemical manures; the same description of manure being, as a rule, applied year after year on the same plat. Besides the experiments on the growth of individual crops year after year on the same land, without and with different manures, so to speak complementary experiments, on the growth of crops in an actual course of rotation, without and with different manures, have been made; as also have others on the mixed herbage of permanent grass land, both without and with various manures. And here it is to be observed that the arrangement of the manures is made entirely regardless of the comparative cost as between plat and plat; the question at issue being entirely one of constituents against constituents, and not of shillings against shillings, or dollars against dollars.

It is obvious that the results of field experiments with the individual crops of rotation conducted as above described, must of themselves throw much light on the characteristic requirements of the particular crop under investigation; whilst those on the growth of crops in an actual course of rotation will serve to confirm and control those obtained with the individual crops, and will, in their turn, receive elucidation from the results with the individual crops. Then again, the results of the experiments on the application of different manures to the mixed herbage of permanent grass land, which includes members of the botanical families that contribute some of the most important of our rotation crops may, independently of their special value in reference to the main objects for which they were undertaken, be expected to afford interesting collateral evidence in regard to the requirements of individual plants thus grown in association, instead of alone, year after year, or in rotation, as in the other series of experiments. Obviously, too, the chemical, and in some cases the botanical, statistics of the various crops so variously grown, and the chemical statistics of the soils of the plats upon which they have been grown, must afford very important data for further study and elucidation.

An examination of the table will show that the individual crops grown separately year after year on the same land, include wheat, barley, and oats, as members of the gramineous family; beans, clover, and other plants, of the family *Leguminosæ;* turnips of the *Cruciferæ;* sugar beet and mangel-wurzel of the *Chenopodiaceæ;* and potatoes of the *Solaneæ.* Then the experiments on rotation include those with members of three different botanical families, turnips, of the *Cruciferæ;* barley and wheat, of the *Gramineæ;* and clover and beans, of the *Leguminosæ.* Lastly, there are the experiments on the mixed herbage of permanent grass land, which includes, besides gramineous and leguminous plants, numerous species of other families.

The first experiments were those with root crops, which were commenced in June, 1843, so that the present year, 1893, is the fifty-first of their continuance. The second were those on wheat, commenced in the autumn of 1843, so that the crop just harvested is the fiftieth grown in succession on the same land. The experiments with beans were commenced in 1847, but for reasons that will be fully explained, they have not been continued up to the present time. Those with clover were commenced in 1848, and have been succeeded by others with various leguminous plants, which are still continued. Then, of the other more important series, those on barley were commenced in 1852, and are still in progress, the crop of the present year being, therefore, the forty-second in succession. Lastly, the experiments on an actual course of rotation were commenced in 1848 and are still continued, so that the present is their forty-sixth year; and those on the mixed herbage of permanent grass land were commenced in 1856, so that this year completes the thirty-eighth of their continuance.

It should be observed that many of the experiments were commenced without any idea of long continuance, and it was only as the results obtained indicated the importance of such continuance that the plan eventually adopted was gradually developed. It is, however, to long continuance that we owe some of the most interesting and the most valuable of our results, as will be fully illustrated as we proceed.

The table further shows the area and the number of plats under experiment in each case, and it may be stated that the total area under exact and continuous experiment has been for some years, and is at the present time, from 39 to 40 acres.

The point I have next to consider is: What is the most appropriate order in which to bring the field and other results relating to these various series of experiments before you? As you will readily understand must have been the case, our selection of crops for investigation was influenced by the actual practice in our own country, the separately grown, individual crops being the chief of those entering into our rotations; whilst the course of rotation selected for study was that which is well known as the four course, namely: Roots, barley, leguminous crop (or fallow), and wheat. Obviously, therefore, the most natural order of illustration would be that indicated by the ideas and conditions in accordance with which the experiments have been arranged and conducted; and, notwithstanding the very widely differing conditions of the agriculture of our country and of yours, I think that the order so indicated will be found to be, upon the whole, not only the most convenient, but the most instructive.

Even in our own country we have a great variety of soil and of climate, and, accordingly, great variety in crops and in the order of their rotation; whilst in your more than fifty States and Territories, extending over such vast ranges of country, the mutual adaptations of soil and climate, and consequently the variety of crops, and the order of their alternation with one another when so grown at all are almost infinite. On the other hand, it is to be borne in mind that one of your most important crops at the present time is wheat, a member of the great and widely distributed gramineous family, and not only was it one of the most important of our crops until it came to be so largely grown by you, but it has been the subject of very special investigations in various aspects, at Rothamsted. Then, maize and the sugar cane are extremely prominent American products, and they, like wheat, also belong to the great gramineous family. True, the conditions under which even wheat is grown are, as a rule, widely different in the two countries, but in some important respects their characteristic requirements are very similar, whether grown in the one or in the other. Maize and the sugar cane, again, in spite of their characteristic differences of requirement, nevertheless show very characteristic similarity of requirement to that of wheat and its allies of the same family. Much the same may be said in regard to leguminous crops, and also to potatoes, as grown in the two countries.

Indeed, I think it will be recognized that, *mutatis mutandis*, the results which have been obtained under given conditions at Rothamsted, are not without their significance and bearing under the different conditions of the American Continent, whilst the modes of experimenting adopted may afford suggestions for the conduct of more or less parallel investigations, varied of course, according to the varied conditions.

In accordance with what has been said, the following list shows in outline the order in which it is proposed to treat of the crops experimentally grown at Rothamsted, and of the laboratory investigations connected with them. It may be explained that Nos. 1 to 6 refer to the crops separately grown.

1. Root crops—turnips, beets, and mangel-wurzels.
2. Barley.
3. Leguminous crops—beans, clover, and various other *Leguminosæ;* also the question of the fixation of free nitrogen.
4. Wheat.
5. Oats.
6. Potatoes.
7. Rotation—root crops, barley, leguminous crop or fallow, and wheat.
8. The mixed herbage of permanent grass land—produce and composition, botanical and chemical.
9. Rainfall and drainage—quantity and composition.
10. Results of experiments on the feeding of animals.

Those of you who have seen the Rothamsted exhibits in the great exposition will recognize that they have been arranged to illustrate the results of the experiments enumerated in the list I have just given, and that the order of subjects is, in the main, the same in the two cases. Indeed, as has been already said, a prominent object in the selection and arrangement of the exhibits was that they should give a comprehensive view of the plan and results of the fifty years' experiments, and that they should also serve the purpose of illustrations to my lectures.

At the conclusion of Sir Henry Gilbert's lecture President Fairchild, of Kansas, delivered an address on "Intellectual development in agricultural education."

WEDNESDAY, OCTOBER 18, 1893, MORNING SESSION.

The Association was called to order at 10:20 o'clock.

Mr. ALVORD. As to the program for to-day the executive committee has issued a program which was intended only as a starter, leaving the convention to determine, after getting to Chicago and seeing the various attractions, how it would conduct itself as to time and duration of sessions. The committee presents as a program for this morning a general business session of the convention. It is believed that if the convention thinks best the business of the Association (or nearly all of it) can be completed at the present session in time to adjourn by half past 12 o'clock. The afternoon session will be in coöperation with the Congress on Agricultural Education and Experimentation, papers being read from the Sections on Agriculture and Chemistry and Mechanic Arts.

The Association is invited to visit the joint college and station exhibit at the Exposition to-morrow morning at 10 o'clock. I will announce for the sections that they may obtain a hall for meetings at any time on application to the gentleman in charge of the building.

The program was approved.

The PRESIDENT. The Section on Botany and Horticulture will meet in this hall at 4 o'clock this afternoon.

Mr. ATHERTON. I move that a committee be appointed by the chair to nominate officers for the ensuing year.

Motion carried.

The PRESIDENT. The topic for discussion this morning is the relation of the Association to the dairy test at the Exposition.

There has been in progress since May 1 what is thought to be one of the finest pieces of scientific work ever conducted anywhere in the world. It has a number of peculiar features. In the first place it is a public test; in the next place it is a general test. It is of the highest credit to this organization that we are the controlling influences; that the test has been left to be practically managed by delegates of this body appointed last fall at New Orleans. This has been a gigantic undertaking. As I understand, it has taken four trained bookkeepers to simply record the figures.

Prof. Scovell, of Kentucky, chairman of the test committee, will present you with the different features of the test. I will, however, not allow him to read all the figures.

Mr. Scovell presented the following paper:

REPORT OF THE COMMITTEE ON DAIRY TESTS.

The rules governing the dairy test at the World's Columbian Exposition, among other things, provided for the appointment of the committee on tests, said committee to be composed of four representatives of the Association of American Agricultural Colleges and Experiment Stations and such additional members as may be furnished by associations or breeders representing breeds competing, one member being allowed each competing breed. This committee was to have general charge of the tests.

At the New Orleans meeting of this Association, by request of Hon. W. I. Buchanan, chief of the department of agriculture, World's Columbian Exposition, this Association nominated to him four members of this committee, namely, M. A. Scovell, S. M. Babcock, I. P. Roberts, and H. P. Armsby, to represent the Association. Subsequently Mr. Buchanan appointed these members, together with other members, as provided for in the rules, and called the committee together in Chicago on the 6th of last February.

The committee there organized by electing M. A. Scovell chairman and H. H. Hinds, representing the Shorthorns, vice-chairman. Mr. Valancy E. Fuller represented the Jerseys, and W. H. Caldwell the Guernseys. At a subsequent meeting the commitmittee elected H. P. Armsby secretary. At this and a subsequent meeting the members of the committee suggested many minor changes in the rules, mainly for the purpose of making the individual cow tests and the breed test uniform as to results.

Following are the essential features of the rules as finally adopted:

First. The selection of the cows for the test to be made by the various cattle associations, respectively, each association to be responsible for the feed and care of its cows. Some criticism has been made as to this feature of the rules, especially as to the matter of feeding. It has been maintained by a few experimenters and others that the committee on tests should have had authority to regulate the amounts and kinds of food to be given the cows, in order to have uniformity in this respect among the different cows and breeds. The advocates of such a proposition do not seem to understand the real purpose of the test. The proposition which they lay down is: Given a certain quantity of food, which breed or cow can make the most butter or cheese from it? Whereas the real problem contemplated by the rules is: Given a cow or a breed, how can she or it be best handled and fed in order to produce the greatest profit to the owner? This problem is what brought the breeds here to battle for supremacy, and it is well that the responsibility of the selection, care, and feeding devolved upon the cattle associations, for it undoubtedly brought the best cows available for the purpose of the different breeds competing into the test, and it will also prevent the different associations competing from claiming that had the cows been handled differently or fed by those who knew them best the results would have been otherwise.

Second. The rules provide for four tests, the net profit produced by any cow, cows, or breed during any test to be the basis of awards. In all the tests the food eaten by any cow to be charged to her at a fixed price for the different articles, the price being fixed by the chief of the department of agriculture, based upon the average market prices of the various articles at the time the rules were drawn.

TEST NO. 1. *The cheese test.*—Time assigned, fifteen days, May 10–25. The breeds competing were the Jerseys, Guernseys, and Shorthorns. Number of cows in each breed, 25; total number, 75. The awards in this test to be based upon the value of the cheese and whey made and the increase or decrease in live weight, less cost of food. The milk from each breed to be kept separately and made into cheese by uniform methods, the cheese to be cured, and then rated by expert judges. A fixed scale of prices was laid down for cheese, depending upon the rating, prices varying between 8 and 16 cents. The price of whey was fixed at 8 cents per 100 pounds. Each cow to be weighed the first five days of the test, the average of these five days to be taken as her weight at beginning of test; also to be weighed in like manner at end of test. If the last average weight showed an increase over the first weight, such increase to be credited to the cow at 4½ cents per pound. If she decreases in weight such decrease to be charged against her at 4½ cents per pound. Each cow to be credited each day with that proportion of the cheese made by the herd to which she belongs, which the total solids found in her milk bears to the total solids of the breed, and with that proportion of the whey which her milk bears to the total milk of the herd.

TEST NO. 2. *The ninety-day butter test.*—Time, from June 1 to August 29. The cows in cheese test alone eligible to this test, with the exception that two alternates from each breed might enter this test. Number of cows in test, 75.

Awards in this test based upon value of butter, skim milk, and buttermilk produced, and gain or loss in live weight, less cost of food consumed. The milk from each breed to be kept separately and creamed separately by a uniform approved mechanical process; cream to be handled and churned by uniform method for each breed.

Butter color, if used, to be charged against breed using it at usual prices, butter to be sampled and the amount of butter fat to be determined in the butter of each breed daily. Credit to be given for the number of pounds of butter containing 80 per cent of fat, which such amount of fat would make.

Uniform packages of butter to be preserved for rating, and scored weekly. Butter to be credited according to a sliding scale of prices based upon the score. The prices were agreed upon before the tests began and were supposed to represent the average retail price of the finest butter at the time. The skim milk and buttermilk to be weighed and solids determined. Solids-not-fat in the skim milk and buttermilk to be credited at 2 cents per pound. Increase in live weight to be credited and loss to be debited, as in test No. 1.

The amount of butter made by any breed daily and the amount of solids-not-fat in the skim milk and buttermilk to be prorated among the cows of that breed. Each cow to be credited with that proportion of the butter made by the herd to which she belongs, that the amount of fat found in her milk by analysis bears to the total amount of the fat found in the milk of the herd, and with a similarly ascertained proportion of the solids in the skim milk and buttermilk found in the herd.

TEST NO. 3. *The thirty-day butter test.*—Any cow, Jersey, Guernsey, or Shorthorn, to be eligible to this test. Number of cows from each breed, 15. Total number of cows, 45. In this test the Jerseys substituted 3 fresh cows, the Guernseys 5, and the Shorthorns 4, the other cows in the test being carried over from tests Nos. 1 and 2. Credit to be given for butter alone in this test. Awards to be based upon value of butter, less cost of food.

In this test the superintendent of a herd had the right to designate how the milk of the herd should be handled at the dairy and how the cream should be separated and butter made. The choice was also given him to have the milk of individual cows churned separately. Otherwise the methods were the same as in test No. 2.

TEST NO. 4. The rules provided for a young herd test, animals to be of same breed as competed in other tests and not to be over 3 years old on September 1, 1893. The awards to be based upon the same condition as test No. 2, the ninety-day test. Subsequently, however, on recommendation of the committee, the rules governing this test were changed as follows:

"Saturday, September 30 to October 20, inclusive, 21 days. Breed test No. 4.—This test will be of young herds entered in accordance with Section 7 of the rules, and will be conducted under the same conditions and requirements, and the awards will be upon the same basis as provided for in Test No. 2, except that the amount of 80 per cent butter produced be calculated from the fat in the milk from day to day as found by analysis, and that the butter so found be rated at the uniform price of 40 cents per pound, and that credit be given for all of the solids-not-fat in the milk at the rate of 2 cents per pound."

Two breeds competed—the Jerseys with 7 heifers and Shorthorns with 6.

The rules provide against substituting one cow for another, against giving stimulants, and against giving medicine except by official veterinarian, and excepting certain nonstimulating drugs specifically named which could be given if the operation were witnessed by a number of the committee, not the superintendent in charge. They also provide that the cow shall be milked at stated times and only in the presence of a member of the committee or its representative. That the milk shall be weighed and an aliquot sample taken for analysis, and that in case of sickness of the cow she shall be dropped from the test, until reinstated by the veterinarian. If sick longer than seven days or if she dies, she shall be credited thereafter with the average quality and quantity of the milk given on the first three of the ten days prior to her sickness, increased or decreased by the per cent of increase or decrease of the products of the herd to which she belongs. Such estimates to be specially noted in the records. (This was necessary to provide for constant comparison of an equal number of cows in the several breeds.)

In case the weight of milk from any cow or breed is lost, the average of the corresponding weights for the two days preceding and two following shall be credited to such cow or breed. In case any sample is lost its composition shall be assumed to be the average of that of the corresponding samples for the two previous days, and the cow or breed shall be credited accordingly. If the weight of butter be lost, its amount shall be calculated from the amount and composition of the milk on the basis of the average results in skimming and churning, or cheese-making, obtained for the same breed during the two days previous and the two following.

It was evident to the committee that the plans for everything necessary in carrying out the tests under these rules should be thoroughly considered and well matured before the tests began, in order to secure successful accomplishment. One of the most important things to be considered was how to keep a constant watch over the 75 cows which entered the tests, in order that results might be trustworthy. To accomplish this purpose, guards were stationed in each of the dairy barns both night and day, with positive instructions to allow no food to be brought into the barns or to be given to the cows except when the properly authorized person was present to attend to the weighing of food, to report any irregularities as to feeding, milking, or giving medicine to cows, to watch the milkers and see that no extra milk or cream was put into the milk buckets while milking.

To assist the committee in their work, three assistants were appointed, one for each of the three breeds. These assistants represented the committee in the barns and were authorized to weigh and record the feed of the cows, to weigh and sample the milk, seal the feed bins and the milk cans and the sample-carrying cans. They were present at every milking and feeding. These men were appointed by the chief of the department of agriculture, on recommendation of the committee on tests, and were generally young men from the stations and colleges. These representatives, as well as the guards, were frequently changed from barn to barn and were under instructions to watch the milkers and feeders in such manner that they could be confident that no irregularities took place.

In order to systematize and facilitate the work the cows were numbered from 1 to 25 in tests Nos. 1 and 2 and from 1 to 15 in test No. 3, and these numbers (and not the names of the cows) were used in all the records.

The scales used were decimal, weighing to one tenth of a pound, and were tested from time to time. The milk pails were uniform in weight and size; the carrying cans were of uniform size and varied but little in weight.

The milk as drawn in each barn was brought to the representative of the committee, who weighed it and recorded the weight. He then poured it into a special sample pail and took a uniform aliquot sample with a sampling tube made especially for this purpose, pouring the sample of milk into a sample jar corresponding in number to the cow. The rest of the milk was poured into the carrying can. Whenever the carrying can was full the milk was mixed and a sample taken by means of a sampling tube, and the sample was put into a sample jar marked X.

There were provided for taking samples a number of sets of 26 one-half pint Mason sample jars. Each set was placed in a galvanized iron box of just the right dimensions, and containing handles and a cover, which could be easily sealed. The sample jars were numbered 1, 2, 3, to 25, and X. The different sets were of nearly uniform weight.

After the milking and sampling were finished a member of the committee or one of its representatives sealed the carrying can and the box of samples. The former was sent to the dairy building and the latter to the laboratory. Subsequent milkings of the same day were treated in the same manner, the sealed box containing the samples being brought from the laboratory and opened in the presence of the superintendent of the breed or his representative and of a representative of the committee, and the samples from the same cow being united. After the last milking of each day the sealed boxes of samples were collected and taken to the laboratory for analysis. The sample box was weighed empty before it left the laboratory and again when it returned from the barn after the last milking. This, together with the weight of the milk taken at the dairy, gave a check on the weights of milk as reported by the committee's representative taken at the barns.

The work in the laboratory was under the direct charge of Dr. E. H. Farrington, chemist of the University of Illinois Experiment Station. Associated with him were five and sometimes six assistant chemists, selected from the various stations, and who were especially fitted for the work in hand. Dr. Farrington organized the assistant chemists in two divisions. Each division working independently on the same samples, thereby insuring strictly independent duplicate work. The fat in the milk was determined by the Babcock test and the solids-not-fat by the Quevenne lactometer. The butter was analyzed by the official method.

Dr. Farrington deserves much credit for the manner and skill in which the laboratory work was carried on. He had many difficulties to contend against, but the results show conclusively that he was the right man in the right place. Dr. Farrington made his report daily to the committee, handing in the original results as well as the average of duplicates for the inspection of the committee.

When received at the dairy the seals upon the cans containing the milk were examined to see that none were broken, after which the cans were opened by a member of the committee or by its representative. The milk from each breed was then thoroughly aërated and cooled. The can containing the milk was then placed in a refrigerator room and kept there under lock and seal until the separating, which was done each morning between 9 and 11 o'clock.

The milk from each herd was weighed just before separation, the difference between this weight and the weight of milk in the barn, less the weight of samples, giving the mechanical loss. This loss usually amounts to from 5 to 7 pounds, and any wide discrepancy from these figures showed error in some part of the work, which was immediately investigated. When such discrepancy could not be satisfactorily accounted for the yield of butter for the day was estimated according to rule 20. Necessity for such action occurred only once or twice during the whole test. The total milk for each day from each herd was mixed together in a receiving vat and warmed to a proper temperature for separation. After separating with the centrifugal the skim milk and cream were both weighed as a check upon the first weight taken. Samples of skim milk were taken for analysis with a Scovell tube in the same manner as from the mixed milk. The cream was immediately cooled to a proper temperature for ripening and placed under seal until churned; when ready to churn the cream was again weighed and the weight compared with the weight when first separated, in order to detect any loss in handling. When churned, a sample of the buttermilk was taken for analysis in the same manner as that of the skim milk. When salted and worked, while spread upon the worker, a sample of butter was taken for analysis by taking small portions from different parts of the worker. It is believed that fairly representative samples were obtained in this way. The butter was then removed from the worker and weighed, together with the sample taken for analysis. A 5-pound package of the worked butter was packed for the judges and placed under seal in a refrigerator until judged. The butter was judged every week by three judges, who made their scores independently of each other, the butter from each breed being designated by number, no one being present except the judges and the attendant who brought the butter to them. When completed each judge placed his individual score in an envelope addressed to Chief Buchanan, who, after removing the signatures, sent the scores to the committee.

Throughout the whole test each step of the dairy work has been carefully watched by some member of the station committee or its representative, and every precaution against fraud or error has been taken.

During the cheese test similar precautions were taken to guard and care for the milk previous to manufacture. Separate vats were provided for the milk from each herd into which the milk was weighed and made into cheese on the Cheddar plan by expert cheese-makers. When taken from the press the cheese was weighed and a lead seal similar to those used upon the milk cans was affixed to each to designate the kind of milk from which it was made. The cheese from all of the breeds was kept in the same room, which was locked and sealed, no one being allowed to enter it except in the presence of a member of the committee. When properly refined the cheese was judged by three judges appointed by Chief Buchanan, the same precaution being taken as with the butter, the judges being in every case ignorant of the kind of milk from which the cheese was made. In both the cheese test and the ninety-day butter test, the milks from the three herds were handled as nearly as practicable in the same manner as provided for in the rules governing these tests.

The question of blanks for keeping the records occupied the attention of your members of the committee as early as February. After many consultations and considerable work, a set of blanks was adopted which have worked very satisfactorily. A series of small blanks of original entry were provided as follows:

A blank for feed records, a blank for milk records, a blank for laboratory milk record, a blank for dairy records, a blank each for buttermilk, skim milk, and butter analysis records, and last, a ledger record on which the figures from the original entry blanks were copied each day and the necessary computations made.

The original records were made in duplicate by means of carbon paper, the original being delivered at once to the secretary of the committee and the duplicate copy given to the superintendent of the breed which it represented.

At the daily meeting of the committee the original entries were submitted to the superintendents of the respective breeds for approval.

The test has been unique in many particulars. It has furnished opportunity for the study of dairy problems such as could only have been secured under the auspices of such an organization as the World's Columbian Exposition and such as may never occur again.

The cows entered were picked representatives of their respective breeds, selected by experts in the most careful manner and in number sufficent to afford as fair representation of the breeds as we can ever hope to attain. These cows were fed and handled throughout the test by persons fully conversant with the breed and individual peculiarities of the animals, and who had had large practical experience in the care and management of dairy stock.

The test was of sufficient length to fully test the staying capacity of the cows, some individuals having been under continuous observation for four and one half months. The records of the test, as provided for in the rules, are of the most complete character, and every precaution that ingenuity could suggest was provided to secure absolute accuracy and trustworthiness.

In brief, the test represents an unusual combination of the best practical skill and the best available scientific methods, under conditions such that the results are put beyond reasonable doubt as to accuracy.

This has not been attained without extraordinary expenditures. While no complete statement of the cost of the test can now be made, the following may serve to suggest its magnitude:

COST OF THE TEST.

A. To the Cattle Association:	
1. Selection and transporting cows	$18,000
2. Salaries and wages	
3. Cows killed	
B. To the Exposition:	
1. Stables and dairy buildings	67,000
2. Feed	
3. Salaries	
a. Dairy force	
b. Chemist	
c. Clerks	
d. Superintendent of feed	
e. Labor	
C. To the stations:	
1. Expense of committee	6,000
2. Time of committee	
	121,000

There has been, as yet, neither time nor opportunity for careful study and discussion of the vast amount of data accumulated in these tests, but it is already apparent, even in the most cursory scrutiny, that results of the greatest interest and value may be expected from systematic, thorough, and impartial study of the facts now on the records in the books of the committee.

It is our confident belief that these results will be well worth all the expenditure necessary to secure and disseminate them.

The report of your representatives upon the committee would be incomplete without mention of the very pleasant and gratifying relations which have existed throughout the test with the chief of the department of agriculture and with the representatives of the several breeders' associations.

By his unfailing courtesy and unreserved support, his prompt compliance with every reasonable request, and his unstinted recognition of the efforts of your representatives to faithfully perform the duties assigned them, Chief Buchanan has placed us under obligations to him which it is a pleasure as well as a duty to recognize.

Our associates in the committee, too, have met us in the most friendly manner, and the whole committee has worked harmoniously together throughout to secure what all had at heart, an absolutely fair, accurate, and unprejudiced test.

Mr. ATHERTON. While Prof. Scovell was reading it occurred to me that this was a fitting time to express to this committee our appreciation of their work, and I have hastily prepared a resolution which I will read and ask that it be referred to the proper committee:

Resolved, That the thanks of this Association be, and hereby are, conveyed to the committee on dairy tests at the Columbian Exposition for the thoroughness, fidelity, and skill with which they have discharged the very important but burdensome duty intrusted to them, a public service which reflects the highest credit upon the individual members of the committee and upon the Association of American Agricultural Colleges and Experiment Stations, which they have so ably represented.

Mr. ALVORD. I take pleasure in announcing that the executive committee pass at once upon this resolution and unanimously report it favorably for action.

The resolution was adopted.

Mr. ALVORD. I have a few additional resolutions to submit from the executive committee bearing upon the same subject. The committee submits the following, with the recommendation that they be now adopted:

Resolved, That the standing committees of the Association on the collective college exhibit, the collective station exhibit, and the dairy test at the Exposition be continued, with authority to file final reports with the executive committee as a part of the proceedings of the Association for this year.

Resolved, That the Office of Experiment Stations of the Department of Agriculture be requested to make a report of its exhibit to accompany the corresponding reports of the Association committees.

On motion the resolutions were adopted.

Mr. DABNEY. I rise to call attention to some points and to ask for information. Is it possible to publish the ledger sheets of the dairy test record—is that contemplated? Then again I wish to ask what rights or interest have we in these records?

Mr. MYERS. Is it not the expectation that this report will be published as a part of these proceedings? It was certainly done by station workers and reported here. Why not print it as a part of the proceedings?

The PRESIDENT. I think that if you will leave this matter in the hands of the committee they will not allow the records to be lost nor allow the stations' interest to be lost sight of. The matter is somewhat complicated. Though the stations have put in a few thousands, the Exposition authorities have put in ten to our one.

I will now announce, as a committee to nominate officers for the ensuing year, Messrs. Atherton, Dabney, Koons, Thorne, Gulley, Cavitt, and Hays.

Mr. ATHERTON. May I ask if the committee have leave to retire?

The PRESIDENT. Yes, sir.

Mr. TRUE. As chairman of the committee appointed to draft suitable expression of our appreciation of the foreign educational exhibits, I submit the following resolutions:

Resolved, That this Association greatly appreciates the value of the exhibit of the Rothamsted Experiment Station made by the Lawes Agricultural Trust at the World's Columbian Exposition, and it seems fitting that some official expression of appreciation of this exhibit should be made by the authorities in charge of the Exposition.

Resolved, That copies of these resolutions be sent to the proper authorities of the Exposition and to the commissioner in charge of the exhibit of the Rothamsted Experiment Station.

A. C. TRUE,
J. H. WASHBURN,
J. A. MYERS,
Committee.

Resolved, That this Association greatly appreciates the value of the exhibit of agricultural schools and experiment stations made by the Government of France at the World's Columbian Exposition, and it seems fitting that some official expression of appreciation of this exhibit should be made by the authorities in charge of the Exposition.

Resolved, That copies of these resolutions be sent to the proper authorities of the Exposition and to the commissioner in charge of the French exhibit.

A. C. TRUE,
J. H. WASHBURN,
J. A. MYERS,
Committee.

The resolutions were adopted.

Mr. SCOTT. If in order to submit a report from the Section on College Work I should like to bring the following resolution before the Association.

The Section on College Work recommend the adoption of the report of its chairman on "The Instruction in Military Science and its Needs," and submits the following resolutions for the consideration of the Association:

Resolved, That this Association heartily approves of the recommendation of the Inspector General of the Army in his report for 1892, that such legislation be had as will enable the Secretary of War to supply the military departments of the land-grant colleges with the necessary uniforms and camp and garrison equipage; and

Resolved, That the executive committee is instructed to confer with the proper authorities on this subject and take such other action as may be found necessary to secure the favorable consideration of this recommendation.

On motion of Mr. Bondurant the resolutions were adopted.

Recess was then taken for twenty-five minutes.

Mr. Alvord, on the convention being called to order, presented the following resolutions from the executive committee, with recommendations for their adoption:

Resolved, That the new executive committee be instructed to inform by circular all the colleges interested, of the terms upon which the bust of Hon. Justin S. Morrill can be obtained.

On motion the resolution was adopted.

Resolved, That the dues of institutions eligible to membership in the Association for the ensuing year be fixed at $15.

Adopted.

Resolved, That the executive committee be charged with editing and publishing the proceedings of this convention, in coöperation with the U. S. Department of Agriculture.

Adopted.

Resolved, That the unfinished business of the Association be referred to the executive committee for action at its discretion.

Adopted.

Concerning the resolution of Mr. Kellogg, regarding the distribution of seeds and plants, the committee reports that the proposed action is inexpedient at the present time and recommends that it be laid on the table. Action approved.

Concerning the resolution, introduced by Mr. Cavitt, regarding action to be taken by the Association on the proposed legislation repealing all permanent appropriations (which will include the Morrill Act of 1890), the committee regards the matter as of the highest importance, but it is believed inexpedient to take definite action at present, and therefore recommends that this preamble and resolution be referred to the new executive committee.

Mr. CAVITT. Does that mean that it will be postponed until next year's meeting?

The PRESIDENT. It is in their hands for action at any time. The executive committee represents the Association *ad interim.*

Reports from sections on nominations of officers are now in order. First, the report of the Section on Agriculture and Chemistry.

Mr. FREAR. We report the following nominations: Messrs. Henry, chairman; Brooks, vice-chairman; and Voorhees, secretary.

Nominations confirmed.

Mr. STOCKBRIDGE. The Section on College Work reports the following nominations: Messrs. Fairchild, chairman; Harris, vice-chairman; and Stockbridge, secretary.

Nominations confirmed.

Mr. LAZENBY. In absence of the secretary I report for the Section on Botany and Horticulture nominations of the following as officers for the ensuing year: Messrs. Goff, president; Taft, vice-president; and Pammel, secretary.

Nominations confirmed.

Mr. COMSTOCK. For the Section on Entomology I report the following: Messrs. Osborn, president, and C. M. Weed, secretary.

Nominations confirmed.

Mr. HALL. For the Section on Mechanic Arts, I report for chairman, Mr. Washburn, and for secretary, Mr. Anderson.

Nominations confirmed.

Mr. HARRIS. As chairman of the auditing committee, I respectfully report that the committee have examined the accounts of the treasurer and have found them correct, with proper vouchers for every item of expenditure.

Report accepted.

Mr. LAZENBY. I wish to say that I am authorized by the trustees and faculty of the Ohio State University to invite this Association to meet at Columbus, Ohio, at its next session.

Referred to the executive committee.

On motion of Mr. Myers, it was decided to attend the Exposition the day following and to meet at the exhibit of the Office of Experiment Stations in the Agricultural Building.

On behalf of the officers of Cornell University, Mr. Roberts extended an invitation to the Association to hold its next meeting at Ithaca, N. Y.

Mr. THORNE. I have asked permission of the executive committee to occupy a little of your time. I have a short paper which I wish to present.

HOW CAN WE INCREASE THE ATTENDANCE OF STATION OFFICERS AT OUR ANNUAL CONVENTIONS?

The Association of American Agricultural Colleges and Experiment Stations was called into being by the necessity which those charged with the organization of agricultural investigation in America, under the so-called Hatch Act, felt for conference with each other, in order that this new work might be established with the fewest possible mistakes; and in the first year of our work there was no topic which more urgently demanded our time and thought than those relating to general administration. But it is now nearly six years since the Hatch Act went into effect, and this is the seventh general convention of our Association. Most of our stations have passed through the experimental stage in their organization, and have found and settled into such lines of work as seem best suited to their various conditions and environment. There will, of course, always be some questions of general policy calling for discussion, but I apprehend that in the future such questions will be few as compared with those which relate more closely to the details of scientific investigation. In other words, and to come squarely to the point, I think the time has come when the attendance of those members of the stations' staffs who are most directly concerned in the work of investigation should be looked upon as even more desirable than that of the directors themselves; and I would say the same with reference to those who are charged with the work of instruction in the colleges. The college presidents have done a most useful work, and one which no one else could have done in the organization of this Association, but the time has now come when the very life of the Association demands that they should earnestly plan for participation in its work by such members of their faculties as are engaged in the various departments of research and instruction which come within the scope of our Association's work.

I think I need not stop to argue this point. The Association itself, by practically unanimous action, has decided to enlarge its work, from the mere adjustment of relations between college and station and the coöperative action of all in matters of general policy, into a field which covers the entire work of the American college of agriculture and the mechanic arts and the agricultural experiment station, a field as broad as the universe.

Having set this high ideal before us—and wisely, I believe—how shall we proceed in order to attain the largest possible measure of success? One or two of our shortcomings I shall try to indicate, and in doing so, I wish it to be distinctly understood that I am making no personal criticisms. I believe that every man who has been charged with responsibility in the conduct of this Association has had its interests at heart, and that any falling short of the best possible attainment should be charged to the overload of other duties which too many of us are forced to carry, and not to any intentional neglect. The fact is, that thus far our annual conventions have steadily increased in interest and value, and it is only because I see in some quarters indications of a lack of appreciation on the part of some of those who should be most benefited by the opportunities which these meetings offer that I venture to make any suggestions. For instance, it is not encouraging to look over the report of our meeting at New Orleans and observe that horticulture had but four representatives at that convention, and entomology but two, yet these are two of the most important departments of station work.

One of the chief causes of this lack of appreciation has been the lack of preparation for the convention. When the various sections were first organized it was expected that sectional programs would be prepared and distributed in advance of the convention, but the instances in which this expectation has been realized have been too few to enumerate. Now, it is utterly useless to expect that a man whose work is confined to a single specialty will spend from $30 to $50 a year out of the too meager salaries which most of our station workers receive for the purpose of attending a meeting where no provision has been made for consideration of the problems in which he is most interested. Our sections in agriculture and chemistry have always had a fair attendance, and the reason is obvious. Most station directors are either agriculturists or chemists; but it is evident that there must be a decided change if our conventions are to become a general rendezvous for all workers in scientific investigation in agriculture.

Another cause of apathy on the part of those who are neither station directors nor college presidents is to be found in the practice of sending delegates to our conventions at the expense of the colleges and stations. While we were passing through the organizing stage of our work it was perfectly legitimate that the various institutions represented should pay the expenses of their delegates, but we are past that period now. The American agricultural experiment station is on its feet and is a power in the land, and the question whether it shall retain this position lies with the men who are doing its work; but the man who has not ambition enough to impel him to spend a few dollars yearly for such opportunities of improvement as the conventions of this Association should offer is not worthy of a place in the work and will not long be permitted to retain such a place.

But station workers are like the rest of humanity, and those who are not so fortunate as to have their expenses paid to our conventions naturally feel that it is an injustice that this favor should be shown exclusively to those who are already receiving larger salaries than they, and as a consequence they stay at home or organize themselves into independent societies or join some section of the already overloaded American Association for the Advancement of Science.

I observe, for instance, that at the recent Madison convention of this general association there were well-attended sections in botany and entomology; yet the work in these sections was chiefly done by experiment station men, that in entomology being almost altogether economic and that in botany chiefly so. But this is work that should first appear in the proceedings of our Association, and will do so if we use the proper measure to bring it to us. The idea should be inculcated that the upbuilding of this Association is something more than a privilege on the part of station workers, and if it comes a little awkward on the part of us directors and presidents to insist that our associates shall put their hands in their pockets to develop the scientific work of the Association, while we are having a good time together without expense to ourselves, I think we should at least be willing to divide with them. Thus far our work has had very smooth sailing at Washington, but when Congress comes face to face with a deficit in the National revenues instead of an unmanageable surplus we may expect a close scrutiny of experiment station work. When the work was being organized we could only offer promises, and our promises were accepted, but when the next crisis comes promises will be of no avail. Results will be demanded then, and we shall need to be ready to put forward these results in the most concrete form.

Now, if I were sure that we were ready for them, I would ask this convention to adopt three resolutions, the first of which would be a suggestion as to the expediency of making a more general distribution, or none at all, in the payment of the expenses of station and college officers as delegates to our conventions; but as I realize that this might seem like a hardship in the case of the stations most remote from the place of meeting I merely drop the suggestion and pass to the next, for which I ask the usual reference and final consideration of the convention:

Resolved, That the chairman and secretary of each section of the Association are constituted a committee on program for that section, and that it is made their duty to prepare and submit to the chairman of the executive committee, within twenty days after publication of the call for the next annual convention of the Association, a program for the work of their section in that convention, said programs to include not less than six papers each.

Resolved, That it is the sense of this convention that all scientific workers who are supported wholly or chiefly from funds appropriated by the National Congress for the encouragement of scientific instruction and investigation in agriculture, under the acts known as the Morrill and Hatch acts, should look upon it as a duty to so use the results of their investigations that due credit may unmistakably accrue to the American agricultural experiment stations, separately or collectively.

In other words, I mean by this last resolution that we should say, and I think we should say it emphatically, that in the proceedings of this Association is the proper place for the first publication in full of such papers as appropriately appear in the proceedings of scientific societies, when such papers are the results of work paid for out of these National funds.

Let me illustrate a little: I employ a man to work my farm and pay him a stated salary by the year. He plants and cultivates and harvests my crops, but has he any right to sell or even give away any portion of these crops? or has he any right to go across the road and work a day occasionally for my neighbor without accounting to me for the time? I am employed to edit a newspaper, with the understanding that I am to give my entire ability to that work; have I any right, while so employed, to use the information and experience which I acquire in that work in conducting a newspaper across the street? Yet I have known station workers to do what would be the exact equivalent of what I have described. It will not do to say that this work is all for the public anyhow and it does not matter how it gets to them. It does matter, for the continuance of the work depends upon the people understanding definitely what they are getting for the money they are putting into it.

Mr. ATHERTON. I suggest that we adopt the two resolutions presented. I would like to ask for a report from the executive committee.

Mr. ALVORD. The committee reports the resolutions back without recommendation.

Mr. FREAR. Does the last clause of the resolution mean that no results of scientific work of station men shall appear before appearing in a station publication?

Mr. THORNE. No; but that credit shall unmistakably be given to the station.

After some discussion the resolutions were adopted.

Mr. Harris offered a resolution inviting such inspection of the work of the stations as might be deemed proper, which, after some discussion, was adopted in the following form and as an instruction to the new executive committee:

Resolved, As the sense of this convention that this Association would welcome, on the part of the United States authorities, such inspection of expenditures by the several stations established under the act of 1887 as may be deemed proper by the General Government.

Mr. ATHERTON. If in order, I would like to submit the report of the nominating committee. I am directed by the committee to present the following nominations for officers of the Association for the ensuing year:

President, S. D. Lee, of Mississippi.

Vice-presidents, G. E. Morrow, of Illinois; J. S. Newman, of South Carolina; H. Hadley, of New Mexico; J. H. Canfield, of Nebraska; and William Frear, of Pennsylvania.

Secretary and treasurer, M. A. Scovell, of Kentucky.

Bibliographer, S. W. Johnson, of Connecticut.

Executive committee, H. E. Alvord, of the District of Columbia; H. C. White, of Georgia; A. W. Harris, of Maine; H. H. Goodell, of Massachusetts.

The nominations were accepted and the persons named were duly elected and declared the officers of the Association for the ensuing year.

The following resolution in regard to annual meetings was presented by Mr. Rose, of Texas:

Resolved, That the executive committee be instructed to consider the advisability of holding our annual meetings during the month of June, July, or August.

Mr. Cavitt offered the following resolution in regard to the name of the Association:

Resolved, That the name of this Association shall be so changed as to hereafter read as follows: "American Association of Agricultural and Mechanical Colleges and Experiment Stations."

The resolutions were referred to the new executive committee.

Mr. Atherton extended an invitation to the Association to hold its next meeting at the Pennsylvania State College.

The PRESIDENT. There will be a session of the convention this afternoon at 2 o'clock, to be held in conjunction with that of the Congress on Agricultural Education and Experiment. At the session this evening at 7 o'clock papers will be presented by the Section on Mechanic Arts.

On motion of Mr. Bondurant, the convention adjourned at 1:20 p. m.

WEDNESDAY, OCTOBER 18, 1894, EVENING SESSION.

The following papers were presented by the Section on Mechanic Arts:

SHOPWORK INSTRUCTION AT THE IOWA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS, AMES, IOWA.

By G. W. BISSELL, *of Iowa*.

The following is presented, not as embodying new ideas, but as descriptive of old ideas put into practice, and with the hope of provoking discussion by others who have to do with shopwork instruction in the land-grant colleges.

The shopwork instruction is composed of sixteen weeks of carpentry and wood-turning, sixteen weeks of blacksmithing, sixteen weeks of pattern-making, covering the first year and one half of the second year of the course, and sixty-four weeks of machine-shop practice, with which is incorporated some work in the foundry. A week's work in every case consists of eight hours, usually in two shifts of four hours each.

For the instruction of the various classes a machinist, a blacksmith, and a carpenter are employed. These men are skilled mechanics.

The time of the instructors required for the work of instruction to scheduled classes is about three and one half days per week. The shops are open and the machinery running eight hours per day for the six week days. The instructors, when not employed as above indicated, devote their time to the maintenance and making of tools and to the commercial work of the shops. The latter is sufficient of itself to keep them employed and for a good share of the time additional mechanics are employed to do commercial work.

Students are assigned to work at stated hours in sections or classes of convenient size and are expected to be punctual in attendance as per schedule. Each student is given credit daily on the class book for time spent at work and is required to put in the specified number of hours in each shop. Time lost by absence for good cause can be made up as the student may arrange with the instructor.

The student pays for the material used in shop instruction which does not revert to the shop. For this purpose he deposits the sum of $5 per term with the college treasurer, and an account is kept of charges made against the deposit. These charges include individual material, breakage, fuel for the shop engine, waste, oil, etc., and small tools lost or otherwise unaccounted for. The amount named has been found to more than cover all expenses justly chargeable to students. The balance is refunded.

We have no difficulty in maintaining order in the shops. The incentive to the unwilling student is the time book, the instructor having the right to dock those guilty of disorder, "soldiering," or leaving their tools or benches without cleaning the same.

The work done by the students in the shops is of two classes—exercises and job work. If the student were required to do all the exercises included in the scheme of the course they would serve to keep him employed for more than two years of his shop course. The plan is, however, to shorten this time by omitting many of the exercises and to assign others taken from the commercial work which is in hand at the time. In general, the beginners spend one term upon exercises. In the succeeding terms the exercises become less and less the rule, and are entirely abandoned in the junior and senior years. The job work forms the most interesting and valuable feature of the shopwork for the advanced students. It consists of selected work from the commercial work done in the shops, and comprises the construction of experimental apparatus for the several departments of the college, the repair and construction of tools, apparatus for the shops of our own department, and work done for parties having no connection with the college. A large proportion of the last class comes from a suburban steam railway connecting the college with the town of Ames. This work is a source of revenue to the department. In assigning job work to the students the judgment of the instructor is an important factor. To show the scope of this feature of our work the following examples are given:

A 4 and 2½ by 6 duplex steam pump has been constructed from drawings and with castings furnished by an Eastern maker. A 6-horse-power vertical engine is now under way. A 10 and 5 by 12 steam pump, belonging to the college pumping station, is being overhauled; this includes reboring the water cylinder and the valve seat. For the former, owing to the limited swing of the largest lathe, the boring will be done with a star feed boring bar, which one of the students has just completed for the job. Two small steam engines have been overhauled, involving such operations as reboring the cylinders, scraping the valves and seats, putting in new crank pins, forging and finishing a connecting rod, rebabbitting the boxes, etc. Two special indicator motions for the engines in the mechanical laboratory. A large amount of apparatus for the department of physics, including galvanometers, a hygrometer, ammeters, linear expansion apparatus, 500 binding posts, the students making the special tools for the same to fit an Almond turret head used on one of the lathes.

A more extended list might be presented, but the above will serve the present purpose. It will be seen that the number of accessory exercises involved in the above, such as the making of special reamers, jigs, etc., is sufficient to fill up many hours of the required time. Useless labor and superfluous finish are not encouraged. The student is taught to economize his time. The reasons for every step are explained whenever such explanation is needed.

The results obtained by the above-described features of our work, as measured by the general interest manifested in the work by the students whom we seek thus to benefit, are all-sufficient. As to the permanent benefit to the student thus placed in an atmosphere of business and competition, the writer thinks that there can be no question.

The words of Dr. R. H. Thurston (p. 761 *et seq.*, vol. VII, Transactions of the American Society of Mechanical Engineers) bear directly on this point and are here quoted:

"The question as to whether the shop shall be a business establishment as well as a school, or simply the latter, is a very interesting one. * * * For my own part, I have watched the progress of the two systems very carefully, and can see the advantages claimed for each very clearly; but I see no reason why the advantages of both plans should not be combined. * * * There can be no question that to teach the use of tools first is the first and indisputable duty of the instructor, and that, the use of the tool being once taught, its application in the arts is no less his second and no less imperative duty. I should therefore first attempt systematically and thoroughly to teach the entering pupil the use of the tools of his art. This can undoubtedly best be done by a series of graded exercises. * * * The progress which can be made by the skillful application of this system of exercises is astonishing to one who has not seen it in operation. * * * As a means of attaining skill in the use of tools simply, it is beyond question the only commendable system. A good knowledge of the nature, special characteristics, and uses of the tools of any art being thus taught, the next step, it would seem evident, must be the acquirement of some useful knowledge of the proper and best methods of application of this skill. This can be obtained by an extension of the same general system to a very considerable and useful extent, and, so far as this is possible, there can hardly be any question that this is the best course to take. But this division of the work of instruction demands vastly more than the familiarizing of the student with certain standard and stereotyped methods of forming parts and assembling machines. It demands such variety of work as will give the young man some idea of the thousand difficulties and problems arising in actual practice and in the course of a regular business. Such practice and instruction can not well be given, ordinarily, by deliberately planned exercises, beyond a certain and somewhat limited extent, and the experiences of a manufacturing establishment do, I think, more generally confer upon the novice that kind of knowledge and readiness in adapting himself to circumstances. In fact, it is the habit of promptly meeting emergencies and of inventing and of perceiving on the instant just what is needed to meet unexpected and exceptional demands upon the skill and intelligence of the learner, that actual shop life and practice gives which constitutes its special value in the development of the young mechanic. I also think that the life of the young man in the shop, in the atmosphere of real life which he finds there, must in all cases prove a very valuable incentive to industry, and a good spirit of work and thought. Nothing so greatly stimulates a boy as to be able to feel that he is taking part in a man's work, and doing something which will have a real and immediate practical outcome. It has always seemed to me that if these two methods can be combined, either by synchronous or by successive practice, the result must have a maximum value. * * * I can see a possibility of the two being made to work together. * * * But if the attempt is made to effect this combination, the primary object must be instruction and not the making of money. * * * I should in every case, however, insist upon the preliminary training by systematic performance of carefully planned exercises to such an extent that the student should have acquired a good knowledge of the use of tools of all the familiar kinds in regular use in the principal trades which underlie the work of the engineer."

The equipment of the carpenter shop consists of 14 wood lathes, 16 benches, sets of small tools for 20 students, a combination buzz saw, jig saw, pony planer, molding machine, and mortiser; 2,400 square feet of floor space.

The equipment of the blacksmith shop consists of 8 forges, anvils, tongs, fullers, flatters, swages, swage block, and cone block; 400 square feet of floor space.

The equipment of the foundry consists of a small brass furnace, 4 molders' benches, and small tools and flasks for brass molding and casting; 1,300 square feet of floor space.

The equipment of the machine shop consists of 6 engine lathes from 10 to 20 inches swing and from 4 to 12 feet length of bed, 2 speed lathes, 2 emery grinders, 25-inch back-geared drill press, 18-inch plain drill press, Brainerd universal milling machine, Browne & Sharpe No. 1 universal grinding machine, 24 by 24 inch by 6 feet planer, pipe tools and machines up to 4 inches, a good assortment of small tools in the tool room, and vises and benches for 20 students: 2,800 square feet of floor space.

There are at present about 80 students of all classes taking shopwork.

TECHNICAL EDUCATION.

By C. W. HALL, *of Minnesota.*

GENTLEMEN OF THE SECTION OF MECHANIC ARTS: As we look over the field of technical education and note the progress that has been made, we can see strong reasons for the creation of the Section of Mechanic Arts in this Association. We certainly see the vast amount of work before us as individual educators and as an organization; and we see it even more clearly than we see the work already accomplished in the line of preparation for professional pursuits. Before us is a long stretch of possible progress, while behind lies the kaleidoscope of many minds working along different lines to reach the vantage ground of present things. We can not now discuss the three time phases of the subject; the past is a heterogeneous mass of mingled efforts and accomplishments and the future is as yet scarcely outlined in its trend. Let us therefore take a look at the present, weigh some things within our reach of an educational kind, and estimate, so far as we are able, their bearings on the future of this Association.

The institution of this section—Mechanic Arts—was a significant thing for the Association to do. It is doubly significant for having been instituted in a Southern city and through the persuasive efforts of a Southern college president.* "Tools and the man," as Carlyle put it, is to be henceforth the epic of the South; we all want it to be so, and from every quarter we will take up the cry.

Technical education, as we use the word, means agricultural education as well as education for mechanical pursuits, such as railroad building, mining, or chemical manufactures. Plainly, the development of education along this line sprang from the competition of men. Large numbers occupied in any line prompt many to attain excellence. Unity of effort along a definite plan of work is secured only after long and too often discouraging trial. Such has been the history of agricultural education in America, and such was its history in Germany, France, and England.

The two steps that competition invariably prompts are: (1) Development of a broader market ground and (2) diminution of the cost of production. The former has been secured in every age through caravans crossing deserts, ships plowing unknown seas, and military conquests. The latter is attained by starving workmen and artisans and perfecting methods and processes. In the former lie those incentives to heroism and daring which make manhood noble and mark with sharp definition the patience, fortitude, and endurance of the highest types of human plans and achievements. In the latter step there is a constant calling into play of high ability and inventive genius through a constant consolidation of energy. Here, too, lies the mainspring of unrest and industrial disease. The conditions of this unrest lie deep. The train of evils and calamities befalling society is sure to be a long one before the end—a perfect adjustment of wants to possibilities—is attained. We are not to be discouraged; the development of the moral sense in mankind keeps full pace with the advancement of the knowledge of his material environment.

We can not here enter into the history of those educational institutions where agriculture and the mechanic arts have been taught. While a beginning had been made in both classes of schools long before the passage of the Morrill bill, the extension of aid under that bill to the several States was a wonderful impulse to educational activity. Indeed, let me right here emphasize the fact that interest in such education had already taken root on this side of the sea, and this interest was the impulse which led Senator Morrill and others to work all the years from Buchanan's administration until 1862 to secure the passage of this beneficent law. This, like all other successful legislation, was built upon the sound sense and capacity of the people, and thus we see a reason for the high success of these so-called land-grant schools and all others of related character. Their work appeals to the strong good sense of the people and the people patronize them; legislatures appropriate State aid for their maintenance and the wealthy contribute generously their private fortunes to endow them. The schools in turn are adopting the advice of the pedagogue of two hundred years ago; they are accommodating their studies to the present state of our manners and are studying those things which are of use in the world rather than wasting their energies in the vain endeavor to conform the world to the order of their studies. President Johnston, of Tulane University, told us a year ago that the object of a university is to open the door of the mind; to throw the windows of the soul wide open to receive all the inspiring thoughts of the time. Looking into nature in the spirit of research is the highest object of a liberal training. To reach nature we must use the methods and the tools of our every-day work, our, suses sharpened that nothing in the shape of a fact or a phenomenon escape use and our hands so skillful that they will obey the desires and thoughts of our minds even before the command of the will be given them to follow.

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*President James K. Patterson, of the State College of Kentucky, was the earnest mover in the action.

Having, then, that scientific spirit which is now permeating the intellectual processes of civilized mankind; having founded schools which are characteristic of the times; and resting in the fact that the character of the English-speaking race is prone to consecutive action, that sudden revolutions are contrary to its spirit—we then have all the necessary conditions for a vigorous and long-lived system of education which, in all lines, shall be and become of the highest practical value and usefulness. It shall make engineers, and not merely workmen; generals in the great army of the employed, and not merely officers of the line and the rank and file. A technical education means much more to-day than in 1862. Think what the science of agriculture was at that time; societies for the promotion of agriculture had been established in this country as early as 1784, in which year the Agricultural Society of South Carolina was organized, and Washington had urged improvements in agriculture upon the people, as was shown by his letters to Sir John Sinclair; yet it was not until the eloquence of that genius in chemistry, Justus Liebig, applied his science to the development of better farm crops and more perfect domestic animals and Johnston put into practice as well as into print the results of many experiments in practical farming, that any widespread interest was aroused. So late as 1860 the lectures and experiments of these men constituted the best there was to the science of agriculture. To be sure, the Rothamsted experiments had been begun more than twenty years before Morrill's labors were undertaken; in Germany Albrecht had done noble work and some local results had been secured in America. He who asks why it is that man is so late as the nineteenth century in acquiring his present civilization has food for reflection in the fact that the rise of civilization and the development of agricultural technical education are coincident.

Again, the scientific agriculture of the '60's, viewed in the light of the science of agriculture of to-day, was extremely crude. Even Liebig's knowledge of the chemistry of plant and animal tissues was incomplete. What did he know of sugar manufacture as we saw it one year ago at New Orleans, or of butter and cheese making as we see it to-day in Jackson Park, Chicago, or of methods of planting and harvesting crops as practiced on Minnesota and Dakota farms, or of the preparation of preserved foods of all kinds? To anyone interested in an answer to the foregoing questions, I would point out the difference between Liebig's works on agricultural chemistry and the files of the Experiment Station Record for the past four or five years; and I might mention many other admirable works of authority and reference familiar to every member of this convention. The comparison between the '60's and to-day is still stronger when we turn to the mechanic arts. I have no hesitation in saying that the conception of mechanic arts in Senator Morrill's mind was that understood by us in the term manual training as this work is exemplified in the work of our best high schools. It is simply that training of the hand and eye to enable the workman to use them in unison and secure dexterity in the prosecution of the ordinary arts of every-day life. At that time there were but few schools of high grade for the training of engineers. Those were of a nature to convince the Senator that the people of the United States needed the expenditure of the funds which his bill proposed to set apart for educational purposes. And what was the people of the United States but the great mass of wage-earners like the Senator's constituency in Vermont, and, for that matter, every other Congressional constituency in New England?

Therefore, thirty years ago the term mechanic arts meant what manual training does with us to-day. Agriculture meant a scientific culture of the farm, a careful and systematic management, far in advance, it may be, of what farmers of that time understood and put into practice; yet it did not comprehend the manufacture of sugar as that business is carried on to-day, nor the multiplication of the chemical establishments we call creameries and cheese factories, nor the perfected method of harvesting our cereal crops.

We have convened for the purpose of conferring together about the ways and means of mechanic arts in the agricultural colleges of America. The first thing that impresses me is the condensed character of the work typified by this Section of Mechanic Arts as compared with that by any other section in the Association. Let me illustrate my meaning:

Two capitalists, A and B, have each a half million dollars to invest in a business. After mature deliberation A decides to become a farmer. He examines localities as to soil, water supply, markets, and climatic conditions, and determines upon "diversified agriculture" as giving the most chances for success and the least ratio of failure. He employs a general manager to lay out his fields, locate his barn and sheds, build the houses for his workmen, and takes general charge of the business. Leaving $150,000 in the bank for paying the wages of the first season and meeting any contingencies that may arise in the way of crop failures, storms, fires, or disease, he finds himself the possessor of 7,000 acres of good land with plain strong buildings and a fair amount of machinery. He hires a chemist to analyze his soils, determine upon his fertilizers, examine his water supply, and become an expert assistant in all his investigations. Then an agriculturist is found. As he purposes to keep stock, an expert in breeds and methods of stock-raising is secured; a superintendent of his creameries and cheese factories is next called into his employ; then a horticulturist is brought from the best school of horticulture; and finally a gardener is brought who is recommended for his experience in the Government grounds and greenhouses in Washington. All the rest of his employés are common men of sturdy, honest American, Scotch, Scandinavian, and German stock. He has, then, secured seven well educated, scientifically trained agricultural college men; in short, one for each 1,000 acres of his farm. He proceeds with his enterprise and discovers that he has made so wise a choice of an occupation and of men to aid him in it that three out of his five lines of production are highly successful, and on the whole his fortune grows; he soon has a farm of several thousand more acres than at first and a corresponding number of experts to develop his opening lines of agricultural business.

Now let us follow B, who, seeing the manifold uses of iron in railroad building, mining, manufacturing, and building of every sort, decides upon the establishment of a factory for the working of iron. He selects a location and buys 10 acres, ample ground, well situated for his plans, erects his shops, employs his workmen, builds their tenements, secures an additional acre and establishes his home. Instead of extending his operations over 11 square miles, he occupies 11 acres. He finds competition so sharp that he is driven to employ the very best trained talent, and his roll of experts, engineers, superintendents, agents, designers, draftsman, etc., is a score. The development of his business soon demands more capital, and he protects himself against increasing competition by buying an iron mine, erecting a foundry, building a railroad, taking partners into the business, and calling in another score and more of trained men to look after the various details of his flourishing business.

The foregoing illustration serves fairly, as it seems to me, to represent the difference, in the present decade, between the average application of professional knowledge to agriculture and professional technical occupations. We see in sharp contrast the lines of the agricultural and engineering professional schools. Concentrated masses of men involve the sharp competition of the highest grades of professional business.

Permit me to say a word regarding the great mass of workmen under these two capitalists, A and B, who are not specialists, who expend their muscle instead of their brains in wage-earning. The farmer, probably, I suspect, from the very nature of his occupation, is not skillful in manipulation; sometimes he is a bungler. This is natural enough; the work he does, from its very nature, does not require much skill or care or exactness. The putting of seed into the ground, the killing of weeds, the harvesting, all demand only ordinary treatment. So through generations engaged in such work he has inherited methods and habits. He relies on the mechanics for his tools and all repairs. He can not make a harvester, nor can he even make a pitchfork or a hoe. Indeed, it is not every farmer who can select a hoe constructed according to the best mechanical principles.

But a different condition of things is soon to prevail. The successful farmer of 1900 must be differently equipped from his grandfather of 1850. It has been found that a business to be successful under the sharp competition of to-day must be conducted on a large scale; that is, a vast product turned out with a small proportion of high-priced labor. So, too, with farming. The successful farmer must possess the knowledge of an agriculturist and must add to that the best mechanical capacity, for machines—plowing, cultivating, thrashing, mowing—are essentials in the equipment of the modern farm. Large crops must be carefully cared for. Thus we see that not only must technical schools be built up and developed for the thorough training of men to become engineers, superintendents, and foremen, but manual training and mechanic arts must be developed in our distinctively agricultural colleges. Farmers must be mechanics. The more mechanical farmers will be the more successful ones other attainments being equal.

Too often farmers' boys go to colleges instead of technical schools. They are taught that educated men are lawyers, doctors, clergymen; that engineers grow up beside the level, the lathe, and the engine. They are urged that book farming is poor farming; that the proper training for a farmer is that practical sort gained only on the farm. Yet no wage-earner in the whole wide range of industries is so intelligent as the farmer, who is so slightly under control by his environment, who has higher ambitions for his family of sons and daughters, or who is more patriotic and loyal to his institutions and Government.

Turn now to the community of B. The boy is an artisan, and embryo engineer. This is quite as true in A's community as in B's. In America he inherits a certain natural aptitude for tools; his ancestors conquered nature and her forces quite as much by mechanical ingenuity as by physical strength. Thus the farmer boy, whenever he can, leaves the cultivation of the soil for the more fascinating work of making a cultivator; he leaves the raising of wheat to build a railroad over which to take it to market, or to erect a mill in which to grind it.

The employé of a shop or a mine is a specialist; he develops himself for a certain use in human society in a somewhat more restricted sense than the farmer. Whenever he seeks employment he finds himself examined for strength and endurance, as is the draft horse and the ox. His occupation is the result of a sort of natural selection; he becomes what he is physically fitted for; he draws his pay and takes his place in the community accordingly.

It should be the duty of these schools, founded on the grant which Senator Morrill's wisdom and patient persistence secured, to aid these men. Their families must be placed in improved environment. To be sure, experimental farms and shops and drafting rooms can not be made compulsory; there is not money enough, under that grant even to make them common. But there should be wisdom enough, and far-sightedness and benevolence enough, on the part of college trustees and faculties to encourage to the utmost the development of the mechanic arts in our high schools. Place in every such curriculum in the United States the opportunities to train the eye and hand together, and the average of average artisans and farmers will be vastly heightened. This is not an impossible thing to attain; we must attain it in order to meet the competition which is to environ America in the fast-coming decades.

Let me parenthetically say: Many speak of luxuriance and extravagance as attendants on American life. Let me express the opinion that everything is perfectly natural; we are no more extravagant, nor wasteful, nor lavish than is nature around us. We have grown up in a perfectly natural way into conditions which have environed the American people since 1607. We could not have been otherwise if we would. Wastefulness is a relative term; what is wasteful when labor is twenty-five cents per day perhaps can well be afforded when labor commands $2. There every straw of grain must be picked up by women and children; here we could not afford to do such a small thing. Since habits are of slow and persistent growth, so they are given up after a long struggle. The habits of living which we have grown into through generations will not be surrendered in a day, nor within the period of one or several administrations. We must gradually conform to a new environment if we conform at all.

Let me here suggest a duty to officers and instructors in our technical schools, whether they be schools for agriculture or engineering pursuits. It is founded on the experience of the past thirty years. Those institutions are most successful that are closest in touch with the sentiment of their generation. Experience showed centuries ago that a farmer could not raise figs on thistle bushes, and the builder who "stablished not upon a rock" had an uncertain foundation beneath his structure. It is a hard and discouraging task to build an institution of learning in the face of the plain trend of the times. An education is material; it fits young men for contact with material things; it trains them for this world instead of the next; it develops their tastes and aspirations; it impels to a higher plane of living and thus develops a broader and more enjoyable life. That materialism which makes higher and more perfect the home life of the citizen has its advantages, whatever of censure it may receive. We can not expect every State to develop precisely along the same line of educational activity as our own commonwealth is making successful progress. As each community has its own lines of material success so it has its parallel lines of intellectual bias and progress. A community of sugar producers does not desire a farmers' institute devoted to dairying; neither does a community devoted to the manufacture of boots and cloths care for a school to teach assaying and mine engineering; nor an engineering school want its curriculum filled to the close with Latin and Greek. Let us aim, then, to direct our several States along the plain and unmistakable lines of their destiny. Some of us have tastes, or predilections, or prejudices, perhaps, which run counter to such a course; then let us bury such feelings and work for the great cause of the commonwealth and not emphasize the small matter of our own preferences.

I know a State—I have lived in it more than twenty years—where there has been a constant contention against the evident condition of things. I am within bounds in saying that tens of thousands of dollars have been expended in the effort—and I may say it was a vain effort—to keep a course of study and an organization that nobody wanted sufficiently to patronize. It was not because the people of Minnesota were not intelligent enough for such work, but because they could get all the professional training they wanted in a cheaper and more practical way. While this effort was carried on scores of her sons were obliged to go to other States for the education we would not give because the other useless work must be offered. I venture the assertion if we had done the things we ought to have done and not done the thing we ought not to have done, the foundations of higher education and professional training in our State would be far better and more broadly laid than they are to-day. They would have been laid along the trend of our development as a commonwealth. Professional skill and high scientific attainments would be far better grounded in the thoughts and aspirations of our whole people than we see them now. Yes; keep in touch with the times. Encourage the faculties of your colleges always to act as a unit in the advancement of those lines of study and research which are of the highest character and are the best adapted for the advancement of the enterprises peculiar to your State. Then, when your institutions are old, as we speak of old institutions to-day, citizens will look back and laud the prophetic wisdom of the founders.

To bring our reflections to a close: Paraphrasing Prof. Huxley, our schools—schools of agriculture, technology, general science, and classics—exist. Common sense surely suggests that they be made efficient or abolished. We can not accept the alternative of abolition, as that would knock the keystone out of the edifice we have, since 1862, been rearing. Efficiency means a liberal support in means and in energy of administration. Economy does not lie in sparing money but in spending it wisely. So it is desirable that resources, both public and private, be made available and distributed among our schools. The trend of events now compels us, as never before, to look the future squarely in the face. We see the outlines of an industrial struggle far more stupendous and far-reaching than we have hitherto conceived. It will reach every activity of life. No one can escape it except he die. Technical education is that kind of training which will make future Americans excel future foreigners in this industrial struggle just in proportion as present Americans possess superior aptitude and energy to take advantage of surrounding conditions and bend every circumstance to their good.

The scientific spirit is abroad in the land. It is pervading the masses of humanity. It aims at practical, tangible results. The day is far distant when pure science will be the highest aim of our educators and investigators. The more perfect the attainments of the practical men and teachers of this day and generation, the sooner will come the day of highest attainments in the arts and in all the conveniences and accessories of life.

THE MANUAL TRAINING AND THE APPRENTICE SYSTEM.

By C. RUSS RICHARDS, *of Nebraska.*

One thing that I hope to see taken up by our legislators, and our educators as well, is the problem of the trade school. I believe that our system of education for the mechanical engineer is a most excellent one. The engineering student receives a sufficient amount of shop training to make him familiar with the use of tools and with a good many of the more important shop operations. Our so-called "manual training" schools—whose methods are the same practically as the mechanic-arts schools, but whose ideas are different—are doing an excellent work for the youth of this country. But it is the American trade school which has been sadly neglected.

We can train engineers, or we can teach a boy that he has two eyes and a pair of hands in addition to his brain, but how about the hundreds of thousands of young men who must earn a living and make a place in the world by hard work. Many of these young men have not the ability to become engineers, and, besides, we can not have all engineers and no laborers. The manual training school, pure and simple, does not attempt to teach a trade, and could give them little but the rudiments of any line of work. What, then, will be done with them?

Shall they grow up as unskilled laborers, eking out a miserable existence, doing that which requires no skill or knowledge, and which breaks down any ambition they may ever have had? These are questions of the utmost importance not only to us as educators, but to the General Government as well, for by the number of its skilled artisans can a country's worth be gauged.

As I have before said, the present system of mechanic-arts training and manual training are well nigh perfect for the particular purpose for which they were devised. The mechanical engineer must know the "how and why" of the use of tools, but he may not necessarily be an adept in their use himself, although, if he is, he is much better off.

The manual training schools, while they were not devised for the technical training, are of immense benefit for any person who expects to make a future use of technical training, but for a person who expects to become a tradesman they do not go far enough. The fundamental principles of tool work are thoroughly taught, but it requires an apprenticeship of some sort before anyone could become a journeyman laborer in whatever branch of work he might select. That is, the mechanic arts or the manual training schools are not and never can be complete enough to educate a tradesman, for any trade or professional school to be complete must combine within itself all the points that will be necessary to the successful following of that trade or profession.

We may say, then, that at present the only way of learning a trade in this country is by an apprenticeship of from three to five years, providing, always, that the boy can secure a place as an apprentice.

Being curious to know the present attitude of prominent machinery builders and manufacturers to the apprentice system and the system of mechanic arts and trade schools, I sent a number of questions to some of our representative firms in this country, bearing directly on this subject. I confess that I was very much surprised at some of the replies. I desire to give as much prominence to the opinions of these men as is possible, although I may not agree with what they say.

My first question was: "Will you take an apprentice in your shop?" To this question I received nearly all replies in the affirmative from the 16 or 17 firms who were kind enough to answer my queries.

Bement, Miles & Co. say: "Yes; we take 3 or 4 apprentices into our shop every month."

The Yale & Towne Manufacturing Company answer that "We formerly took apprentices, but have not for a number of years. Our present practice is to take young men under instruction, paying them moderate wages, increasing yearly, but without obligation to them to remain for any specified time."

Mr. Bole, superintendent of the Westinghouse Machine Company, says: "Not knowing anything, practically, of the old apprentice system, we can not well draw any comparison between that and our present practice. We have no very well-defined system, but we do take apprentices, giving them three years' term of service, paying them $4, $5, and $6 per week during the three years, respectively. If the boy be unusually bright and capable, we encourage him by paying larger wages. We do not attempt to rigidly treat everybody alike in the sense of giving a stupid boy the same consideration or the same wages as the bright boy. Engaged as we are in manufacturing a specialty, it is to our interest to keep a boy on one class of work as long as possible, so that when he becomes proficient we continue to derive the advantage from his proficiency. Of course, the average apprentice is taught to run a lathe, planer, milling machine, and to do such work as drilling and boring. We have not employed apprentices for fitting work or bench work of any sort, but use older mechanics for such purposes.

Mr. Grimes, superintendent of Williams, White & Co., replies as follows: "Yes, if he agrees to stay five years and work all around the shop."

Mr. F. A. Pratt, of the Pratt & Whitney Company, says: "We do take apprentices, and have now 105, with a large number of applications ahead. We take boys from 16 to 20 for four years, and bind them. We have our selection from a large number of names always on our books. We choose those who have parents who are responsible, and select them by their mental and physical qualifications, and have very little trouble in keeping such boys their full term. The bound apprentice gets a discipline that can not otherwise be obtained."

Chandler & Taylor say: "We take apprentices in our shops, that is, they are called such, but in reality they do not learn the full machinist's trade. They simply go with the trade far enough to become expert as lathe, planer, or machine-tool hands."

J. W. Anderson, superintendent of the Moline Wagon Works, answers: "Yes, I would take an apprentice if I was conducting a machine shop as a business, employing 4 or more men, as in a shop of this kind there is work enough to employ a novice and give him a chance to gradually acquire the handicraft part of the trade.

But as I am at present situated, managing a large factory, using machinery, but not building it for sale, keeping 2 to 4 machinists to keep the factory machinery in repair and make special tools, an apprentice would not be available. This, I think, is the position of most manufacturers whose business is not building machinery.

Prof. Sweet says: "We do have and always have had about half as many apprentices in our machine shop as workmen."

Question 2 was: "Do you believe that the average young man can, as an apprentice, secure the best general knowledge of practical mechanics (I refer to the present time)?"

The J. A. Fay & Egan Company reply that "The average young man can, as an apprentice, secure a good, thorough knowledge of practical mechanics, but only in one branch at a time?"

William Sellers & Co. say that "An apprentice must go to his trade at about 16 years of age, and hence can not have much of a technical education. Apart from that fact, he has an opportunity to gain an excellent knowledge of practical mechanics."

Prof. Sweet answers: "No; even in our shop, which is above the average, I do not think it is a good place to learn the machinist's trade. He gets very little knowledge of anything but steam engines, and that of but one kind."

Mr. Grimes replies: "As a mechanical engineer, no."

Chandler & Taylor say: "As trade is now running everything is drifting into specialties, and therefore an apprentice is an apprentice for a specialist."

The Hendey Machine Company say: "With our system, yes. We teach them all parts of the work."

J. W. Anderson answers: "No, I do not; for, while an apprentice in a machine shop may acquire the manual dexterity that will enable him to do good work, he lacks the knowledge of the underlying principles which govern machine construction. A man with that kind of training does well as long as he has a guiding hand to direct him, but when thrown upon his own resources he usually makes a signal failure. Of course, there are exceptionally bright and ambitious men who will rise in spite of their lack of proper training."

Mr. Pratt replies that "The machinist is not, as a rule, the drudge he formerly was. The milling machine, planer, grinding machine, etc., take the place of hard drudging, and the boy learns to construct and run these machines in place of chipping and filing, as formerly. In our work he has a few months (if he desires and has a fair education and natural talent for it) in the drafting room."

The Westinghouse Machine Company say: "It is difficult to answer this question in a few words. While there is no royal road to learning in the machine business, yet some boys find the road much easier than others. It is doubtless true in a manufacturing establishment such as our own (when special machinery is used, and where nearly all the planning of machine operations is done by the foreman, and the men simply operatives), that there is not the same opportunity for a wide experience as in jobbing shops, when the men do a little of everything, and oftentimes do it as they please. On the other hand, the standard of workmanship in a manufacturing establishment is generally higher; and if graduates of such an institution can not do as many things as graduates of the 'old line' shops, they can generally do what they can do both quicker and better."

The Yale & Towne Manufacturing Company say: "Under existing conditions, in most lines of industry, it is not easy for young men to become apprentices. On the other hand, it is not difficult for them usually to obtain opportunity to become practical mechanics, providing they have fair aptitude and diligence."

Bement, Miles & Co. say: "Most of our best mechanics are those who have served their apprenticeship with us, and the others have all served apprenticeships in some similar establishment. We believe it is the best way to get a knowledge of practical mechanics."

Brown & Sharp Manufacturing Company reply: "We do not believe that the average young man can, as an apprentice, secure the best knowledge of practical mechanics at the present time."

In my third question I ask directly, "Do you believe that the so-called manual training or trade schools give a good foundation for a person expecting to become a machinist?"

Mr. J. H. Springer, superintendent of Frazier & Chalmers, replies emphatically, "*I do not.*"

Mr. Robert C. McKinney, of the Niles Tool Works, answers this question as follows: "The average apprentice starts in with very little education, and many of them with little ambition, and therefore do not become very skilled or expert. An education at a manual training or trade school, gives a young man a good foundation to start on, and applying the knowledge there obtained, he can, in a shop where he is brought in contact with the practical business, make a success of it, and succeed better and be advanced more rapidly than one commencing his trade without these advantages."

Prof. Sweet says: "I have had no opportunity to form an opinion of what is really being done. Do not believe there is any use in stopping short and simply give the boy a foundation, but go on and make him a machinist. That is, a better general machinist that can be made in any shop during an apprenticeship; of course, assuming that funds are supplied for fitting up the plant."

Bement, Miles & Co. reply: "Yes, if the person goes to the training school before entering into a mechanical establishment, it would certainly give him an advantage over one who had not studied the subject at all. We think it would be a better system if boys could learn the practical side at an early age and the theoretical side afterwards. If both could be learned together it would be still better, and this, we understand, the training school attempts to accomplish. They have not been established long enough as yet for their success to be demonstrated by the result."

The Westinghouse Company answer: "We do not know by any personal experience as to the benefit derived from manual training schools, but believe that they ought to have a beneficial effect; and, while it will not take the place of a practical apprenticeship, it is certainly an assistance to any boy who wishes to become a machinist afterwards. In a manufacturing establishment the chief end of the employment of labor is the making of money; therefore, more attention is paid to getting out a product than to the education of the operative for his own advantage."

William Sellers & Co. say that "If the manual training schools have no automatic machinery, and merely teach the boys how to use their eyes and hands, then there is no better foundation for an apprentice, and we seek boys who have had this training."

Mr. Grimes replies: "Yes, so long as the student realizes that it *is* only a foundation."

The J. A. Fay & Egan Company answer: "We believe that the so-called manual training or technical schools are very advantageous to a person expecting to become a machinist. We have had some of that class in our employ and they always take a leading part and become much more proficient in mechanics than the average boy we take in to learn a trade. In other words, this class of boys is just a little better educated than the other, and the practical training they receive in a technical school gives them a great advantage, and they advance in a shop like ours much more rapidly than others."

In answer to this question J. W. Anderson says: "Yes; they not only teach correct and approved methods of doing work, but the theoretical knowledge gained is invaluable. A thorough knowledge of drafting is also of great importance, but seldom learned by an apprentice."

Brown & Sharp answer: "We consider the manual training or trade schools to be a help and good as far as they go."

Chandler & Taylor think that "Manual training or trade schools most certainly give a foundation to a young man expecting to learn a trade, whether it be a machinist, founder, or pattern-maker, but in our opinion a manual training is only a foundation."

Other replies to this question were practically the same as those given above. The next question I asked was: "Is not the vast amount of special machinery now built detrimental to the apprentice system?"

From Mr. Pratt I got this answer: "The vast amount of special machinery now built takes the place of drudgery, and places the machinist on a higher plane. If the apprentice is in a machine-tool works, certainly his practice in designing and building these special machines is so much above that which the writer received fifty years ago that there is no room for argument. Yet the apprentice in any shop will get sufficient practice with cold chisel and file to be of service to him when these special tools are not available."

The Putnam Machine Company say: "Yes."

The Yale & Towne Company answer: "Undoubtedly the continually increasing use of special machinery militates against the old apprentice system, which latter is likely to practically disappear in this country. On the other hand the use of such machinery and the ease with which an unskilled person can become skilled in the use of some one machine enables vast numbers of persons to find better employment than they otherwise could."

Chandler & Taylor reply that "The specialization of work in the various lines would of course destroy in a great measure the old apprentice system."

Mr. Anderson answers: "Yes; for the reason that an apprentice is usually kept on one part of the work, and has no opportunity to become a general machinist. He may be a skilled lathe man, but if so, that is as far as his knowledge goes. This condition is similar with other parts of the work."

The Niles Tool Works answer: "To a certain extent, yes."

Prof. Sweet says: "Yes, as a general thing."

Bement, Miles & Co. reply as follows: "No, not in the least. There are plenty of establishments where apprentices can obtain a complete mechanical education. Mechanical engineering is becoming divided into branches, and no one can be expected to know them all. The apprentice must select the branch he desires to follow, whether it be marine. locomotive, land engine, electrics, machine tools, etc."

The Westinghouse Company think that "As to the special machinery it has its own lessons. It does not throw any obstacles in the way of a bright boy making a good man of himself. It rather teaches him that the chief aim of a mechanic is not to put in time and draw wages by the hour, but to produce some desired result with the least expenditure of time, labor, and money."

William Sellers & Co. believe that "The increased accuracy and expedition in methods of manufacture required by modern practice offset the disadvantages suggested."

Mr. Grimes says: "No; for the apprentice must fit himself to design, build, and repair such machines."

Brown & Sharp answer: "We do not consider the special machinery now in use detrimental to the apprentice system. It gives a different kind of knowledge than that obtained under the old system, but a kind that we think is more suitable for modern requirements."

Question 5 is practically the same as question 4, only in a little different form: "Does not the sharp competition in the manufacturing business cause the boy as an apprentice to be practically shut out from a general knowledge of the machinist's trade?"

Mr. Anderson says: "Yes; especially in what are known as manufacturing machine shops, for the reason given in question 4. The smaller jobbing shops are approximately the only places where an apprentice can get a general training in the machinist's trade, and then usually only the manual part of it."

Chandler & Taylor reply that "The sharp competition in manufacturing has expanded the machinist's trade to such an extent that the average boy does not desire to make himself familiar with the entire trade."

The Putnam Machine Company, answer that "Yes. In a large number of shops manufacturers desire to get all the profit possible out of a boy by having him do one particular kind of work all the time."

Mr. Pratt believes that "the sharp competition compels the invention of new and special machines and processes in which an intelligent boy becomes interested and will try his hand in such improvements."

The Niles Tool Works say: "To a certain extent, yes. An apprentice is more apt to be taught only one part of a trade instead of a general knowledge itself."

Prof. Sweet replies: "If not, then it is the fault of the instructors, growing out of the almost irresistible disposition to teach the theory and principles and then try and put it in practice, instead of keeping the hand work ahead all the time. It is the machinist's business to *learn to do;* it is the engineer's and foreman's business to learn to know and to explain *why.*"

The Westinghouse Company believe that "sharp competition in the manufacturing business should conduce to the best methods in manufacturing, and a sharp boy should not be slow to distinguish as between the shop which can do work cheaply and well and the shop which can not do it cheaply and well. There is an object lesson in this for the boy almost as important as learning his trade."

Wm. Sellers & Co. reply that "many establishments have ceased to take apprentices partly from the cause suggested, but the shops which continue to take them still turn out excellent workmen."

Mr. Grimes answers: "Yes, if the apprentice becomes simply a cheap attendant upon a special tool. This should be arranged in the agreement to serve as an apprentice."

Brown & Sharpe's answer is: "We do not consider that sharp competition in the manufacturing business causes a boy to be shut out from a general knowledge of the machinist's trade. On the contrary, it gives him an opportunity to observe methods and economies which never would be thought of or practiced were it not for sharp competition."

The J. A. Fay & Egan Company answer: "The sharp competition in the manufacturing business causes most factories to use a boy or an apprentice on one class of work. In other words, we put a boy on a lathe and he generally stays there, or we put him on a planer and he stays there, or we put him on a vise and he stays there, and so on; but we have a great many boys who learn all three branches in the same time that one boy learns one of them, and whenever a boy displays any ability of that class we generally move him around and give him a much better opportunity of perfecting himself."

In my last question, I ask directly: "In your opinion is the present system of manual training and trade schools a practical success?"

Mr. Springer underscores his "*No.*"

The J. A. Fay & Egan Company say: "We really believe that the system of manual training and trade schools is a practical success. We have seen quite a number of good mechanics turned out of them, and all they wanted was just a little practical work in a good first-class shop to make them first-class mechanics. We believe that technical schools are doing a great work, especially in the South and West, where shops of our kind are not so plentiful, and it gives the American boy a chance to learn a trade that he could not obtain in any machine shop."

Brown & Sharp reply that "The manual training schools should not be considered as taking the place of the apprentice system, but should be supplemented by an apprenticeship."

Chandler & Taylor say: "In our opinion the present system of manual training in the trade schools is a practical success so far as it goes, but not with the view of the student learning any practical trade, but rather in the line of developing his judgment and the skill of his hands."

From the Putnam Machine Company: "Yes."

Bement, Miles & Co. answer: "It is too early as yet to decide. Every subject should be better understood when special attention is devoted to it, and, therefore, we suppose the manual training schools will have a good effect by causing their subjects to be more intelligently studied. We think it is still open to question whether, if a boy were kept at a good school until 17, and then apprenticed in a good establishment, he would make a better engineer than if he went through a training school. Our Mr. Miles is of the opinion that the only way to make a good engineer is to cultivate his imagination, as the creative or inventive faculty."

Mr. Pratt replies to this question: "The manual training school is a success, more or less, depending upon its management, but it will not take the place of a regular apprenticeship, when productions must be sold at a profit in competition with others. You might as well say that railroads spoiled the old stage coach business and the sale of horses, that the bicycle saved shoe leather and hurt the shoemakers and the leather trade, as to say that labor-saving machinery is making the machinist's trade less desirable. Do all we can in the direction of education and improvement, and there will still be enough hand work and plenty of mechanics who are fit for nothing else but such drudgery."

Such is a synopsis of the replies I have received from some of the most successful firms in the United States. I believe that in a majority of the replies you can secure arguments in favor of the school system of training a tradesman, as against the apprentice system, although in a number of cases the evident intention of the writer was to condemn the school training, or if not to condemn it, to withhold all praise of the system.

We can not but agree that the apprentice system is a good one in some shops and bad in others; in some shops the apprentice is given every possible chance, in others he is given none, practically. But no matter how conscientious a firm may be as regards their apprentices the system can not give good results without a great effort on the part of the apprentice. Although in many of the replies to my questions it is claimed that competition in business does not affect the apprentice, I really can not see how it could help placing difficulties in the way of obtaining a trade, because the cost of production must be reduced to the lowest possible point, and every employé must exert himself to the utmost for the benefit of his employer. How, then, can it be possible to spare valuable time for the instruction of the novice? How will it be possible to allow a beginner to spoil material (and every beginner will spoil a certain amount of stock) when every possible economy must be practiced if the business is made most successful.

It is the necessity of cheapening production that has called forth all the skill of inventors to produce special machines to do the work. These machines cheapen and facilitate production in every way, and we would not go back to the old drudgery, as Mr. Pratt calls it, even if we could, although I am sure that these machines make it more difficult for an apprentice to secure a trade.

A number of manufacturers in answering my questions admit that a majority of boys will be put on a certain line of work, at a certain machine, and in all probability they stay there, becoming in time a mere machine themselves, a part of the one they operate. Of course there is some benefit to the bright boy in seeing new machinery built, but not much unless he understands the details of the machine, and helps in assembling the parts to produce the finished whole. If the apprentice's connection with a new machine consists merely in turning up a piece to a given size and shape, or in planing down a piece as directed by the foreman, he would receive no more benefit from it than he would from turning or planing only comparatively simple work.

Of course, there are firms who endeavor to the best of their ability to give the apprentice a proper training, and with such firms the apprentice can secure a thorough knowledge of his trade. I understand that there are things that an apprentice will learn that could probably never be fully incorporated into a school training. The apprentice must feel a certain sense of responsibility that is ordinarily lacking in the school boy. On the other hand, when thrown upon his own resources the school-trained boy, having been taught to analyze things and to understand the "why" as well as the "how," will be the better able to assume any responsibility, for, if I may say it, the responsibility of the apprentice is more one of fear than anything else.

School methods are such as to impart more knowledge in a given time than any other, for each operation is carefully explained by the instructor, and the reason for each step given, so that the novice can see why a certain thing is done in a certain way, instead of being merely shown how to do the work, and then left to discover reasons as best he can. If a mistake is made it will be corrected by the instructor without making the boy feel that he has committed some crime.

In the school there is also given a thorough knowledge of drafting, which, as Prof. Unwin aptly remarks, is a kind of "written language" for the designer and the machinist. There are some establishments that give their apprentices a chance to learn something about drafting, but they are rare indeed. The foreman usually lays out the work to be done, so there is but little chance even to pick up a knowledge of this very important work.

Aside from the technical work, the boy will be better educated in the school and will make a broader man in consequence. Having a better education than the apprentice-made man, he must advance more rapidly in whatever line of work he may choose.

Believing as I do that the school system of technical training is a success, and that it could be made equally successful in giving instruction to the artisan, I would like to see trade schools organized by the different States. To be eminently successful they must necessarily be kept separate from any other school of collegiate rank, and at all times retain their primary aim of turning out artisans. It would be an absolute impossibility to successfully conduct such a school in connection with a college or a university; for, as Francis A. Walker says, in replying to an article on "Relations of academic and technical instruction," "Young men do not greatly care to go to schools where they are not respected equally with the best; where all the praise and all the prizes go to others; where the stained fingers and rough clothes of the laboratory mark them as belonging to a class less distinguished than students of classics and philosophy."

The school should include instruction in the following trades: The machinist's, the pattern-maker's, the blacksmith's, the cabinetmaker's, the tinner's, the molder's, the plumber's, and the steamfitter's. In certain sections of the country other trades of special importance in those localities should also be added. The practical instruction should begin with a course in the shop similar to that now given in our best technical schools, so that the student would obtain a general knowledge of tools and their use, and thus get a better knowledge of the relations between his own and other trades. After this general tool work, let the student select the trade in which he is most interested, and make a specialty of that particular work. Every detail of the trade should be carefully taught, so that the student will be, in truth, a master of his craft when he completes his course.

Particular stress should be laid upon the scientific principles underlying each trade, and every possible means taken to make the student thoroughly interested in everything he does.

In a school of this sort, after teaching the elementary principles of the work, the most successful policy would be to manufacture articles of a commercial value, wherever possible, and use the proceeds from the sale of such articles for the purchase of new materials. If the proceeds should exceed the expenditures, the balance might be used for the support of indigent students.

The other work of the school should include a thorough course in mechanical drawing, mathematics through trigonometry, a good knowledge of English, some work in history, and physics. In other words, give a good liberal education in addition to the practical work, the whole course extending through three or possibly four years.

As teachers of the trades, well-educated men who have been foremen would be best fitted for the work. If the instructors in all the branches could be men of technical education the school would be the better for it, for the one central idea could then be best carried out.

In suggesting this system of trade schools, I can realize that it would be most successful in the Southern and Western States, where there are but few shops and factories as yet, and where, consequently, it is difficult to learn a trade. Even in the Eastern and Central States, where there are better chances to learn a trade as an apprentice, a school of this sort would undoubtedly be successful, for ordinarily the applicants for apprenticeships are more numerous than are the places for them.

A school of this sort would be a success; it would educate and make skilled workmen of a class that would otherwise receive but little education; it would interest a man in his work for his work's sake, and he would consequently strive to improve himself and make himself better fitted to do his work. New means of enjoyment and recreation would be opened to him, and, even though he always remained an artisan, his life would rise above the mechanical existence of the ignorant laborer.

Mechanical Drawing in Technical Schools.

J. J. Flather, *of Indiana.*

The comparatively recent rise of engineering as a profession and its rapid growth have called into existence numerous technical schools for the education of the future engineer, which have been organized and oftentimes controlled by those who have derived their ideas of proper methods of professional training from inherited or acquired experience in teaching the old or "learned professions"—theology, medicine, and law.

In the learned professions intellectual development is the primary thought, whereas in the education of the engineer the aim is to so train the student that he may have a thorough conception of the principles upon which the profession is based, and such practice in applying these principles as will best enable him to succeed in whatever branch of engineering he may enter after leaving college.

Whatever intellectual development the student may acquire is a result of the process, not the direct aim.

Considering the newness of engineering education, it is not surprising that features exist and are carried out in the curricula of some of our technical schools which only in a measure attain the desired end.

Owing to the comparatively short time they have been in use these features have not been generally recognized, or, if recognized, the adherents of the old school have opposed any change.

Another reason for their existence is the fact that each new school is equipped with instructors and professors who usually adopt the methods they were taught; hence we see in certain lines a general similarity of instruction which, although it may promote the knowledge of the student and enlarge his mental capacity, does not best subserve his ultimate advancement.

While we recognize that the subject of engineering education is not sufficiently old to be crystallized into a definite form, and while we further recognize the advisability of having different kinds of engineering schools—some having departments for shop practice and others providing courses where manual training is omitted—yet there are many subjects which are commonly included in all courses for engineering students, prominent among which is mechanical drawing.

This subject, as frequently taught, does not give the student that training, of which we have already spoken, which will enable him to make the greatest advancement after graduation.

The actual system of projection as taught by many professors is opposed to shop practice, and the student so taught, when he enters upon the duties of his profession, has not only to learn the shop methods, but he must forget much of what he has previously learned.

As drawing is the language of the engineer, it is of the greatest importance that the student be properly taught to express himself, and that his methods conform to those in vogue among practical men. You are doubtless familiar with Chordal's boy Joe, who wrote 22 pages of legal cap to explain a detail drawing. A drawing which requires explanation does not fulfill its mission. A draftsman can not always be at hand to interpret his drawing, nor should he be. Drawings for use in the shop, right at the draftsman's hand, should be so complete and self-explanatory that a properly skilled workman a thousand miles away could execute the work without a word of descriptive matter.

The machine-shop drawing is simply a memorandum, showing what is to be produced. It is necessarily an illustrated memorandum, and to be perfect it should answer all questions which a workman can reasonably ask in regard to the work.

It is not necessary to have a finely-finished drawing: in fact, shop drawings should not be finely finished. A clear representation of the piece with good heavy lines and distinct dimensions, even if drawn freehand, is to be preferred for shop use to a highly finished fine-line drawing which the college graduate is so prone to turn out when he first enters a drafting room.

As freehand sketches enter largely into the work of the engineer the importance of teaching freehand drawing can not be overestimated; and although it may not be generally considered as mechanical drawing, yet its common use in the drawing room and shop entitles it to be properly classed under this general head. Moreover, in this connection it is most frequently used to give form to an object in a manner similar to that employed in mechanical drawing. In this respect it differs from artistic sketching, which gives a general representation of the prominent features of an object or scene.

Freehand drawing is a wonderful aid in the cultivation of the observing powers, and practically the first step in drawing is to learn to see accurately. One of the foremost American engineers of the present day, whose name you would recognize were it mentioned, has so cultivated this power of observation that he has in several instances comprehended the details and dimensions of a machine so completely by inspection that he has been able to make working drawings and duplicate the machine without making a single measurement or sketch.

The beginner will soon recognize that the untrained eyesight is untrustworthy, and when this is realized the importance of keen observation becomes apparent. Erroneous conceptions which the untrained eye will cause the hand to execute may be corrected by intelligent practice, and for this purpose the student should early be given a course in object drawing.

His first work should consist of exercises in drawing straight parallel equidistant lines, both horizontal and vertical; then should follow exercises with curved lines and circles in the flat, after which the student should be given a few examples in shading with the pencil from copy. At this time he may be given simple objects and machines to sketch, and the relation of the several views of a mechanical drawing to the object represented and to each other should be early impressed upon his mind. For this purpose actual machine pieces and combinations will be found of greater value than geometrical forms or wooden models, for a machine piece not only presents a greater range in offering several views which may differ in some respect, but it is the general experience that a boy takes to such drawing more readily and with greater interest.

As the work progresses the student should take measurements from the objects to be represented and the sketch should be dimensioned according to the conventional shop methods.

Another advantage in employing actual machine parts is thus obtained, for where a measurement is a little above or below a standard size the student must exercise his judgment in deciding upon the suitable dimension to adopt—a point which the draftsman must learn sooner or later.

A valuable exercise in freehand drawing is given by introducing, from time to time, memory sketches in which the student has to draw a given piece after an examination of the part. Time sketches are also an aid in teaching this work and should be alternated with the memory sketches.

An aid to the proper disposition of the views in a mechanical drawing is the conception (proposed by Mr. Sellers) that the object is surrounded by a glass case hinged on all sides and so constructed that it can be opened out flat as shown in the sketch on blackboard. By assuming this case to be placed over the object to be drawn, the top view will be seen by looking on top of the object; the front view will be seen from the front; and the right and left views to the right and left of the front view respectively. By tracing the outlines of these several views upon the glass and opening out the case the several views will be placed as follows: The top view will be shown on top, the front view will appear immediately under the top view, and the end views will be drawn to the right and left of the front view and in line with the latter, so that the position of the drawing indicates the view taken. This disposition of the views has so many practical advantages that it is employed almost universally in the shops.

Exercises in lettering should begin with the first work in freehand drawing and should be continued throughout the entire course. There is nothing which discounts a drawing so much as poor lettering, and there is scarcely one graduate in twenty who, upon leaving college, can print his own name rapidly so it will look well. A part of this fault lies with the teacher, who must bear constantly in mind that the old proverb, *poeta nascitur non fit*, does not apply to lettering. The man who would letter rapidly and neatly must acquire the ability by continued practice; he is seldom born with a pen in his hand. The student should be given one or two simple forms of letter which can be made rapidly, and all his subsequent work should be confined to these simple forms. It is folly to attempt fancy lettering, and time spent on such work is thrown away, for no office draftsman could spend the time necessary to make such letters. A plain block letter for titles and a runnng law Italic, a plain Roman, or a style of round writing, are the only forms which the student should try to master.

The writer has adopted a plan which is productive of good results and one which might be carried still further to advantage. It is that in all exercise work and in weekly tests all subject headings, with name and date, must be neatly printed offhand. This gives continual practice in addition to that obtained in the drawing room, and it is found that the men gradually acquire a fair degree of rapidity and style.

In this groundwork the principles of projection should be thoroughly inculcated in the mind of the student, as much of his after success and advancement depends upon his thorough knowledge of these elements.

The time spent on this freehand work is, in most colleges, too short to accomplish much good. It is the writer's opinion that the average student is in a better condition to enter upon the more advanced work of drawing and machine design by a thorough course in freehand, and that ultimately he accomplishes much more than if such time were devoted to instrumental work. From four to eight hours per week may be advantageously devoted to this work throughout the first term of freshman year.

At this time instrumental work should be taken up, and right here much valuable time is wasted in elementary exercises in line work, consisting of the construction of geometrical diagrams arranged with a view to securing facility and accuracy in the use of instruments.

Why not start the student upon projection drawing at once and let him acquire facility of execution at the same time he is obtaining practice in projection? His experience in freehand sketching has taught him the principles of projection and his subsequent work with the T-square and compass should be in the nature of a development. Let the student then be given machine pieces and simple machines suited to the capacity of the individual from which he must make working drawings. By the use of notes, blackboard, and elbow work, let him know what constitutes a good working drawing and let him use the ordinary conventional shop methods of representation. Have good examples of shop drawings so disposed in the drawing room that he may refer to them for comparison and for such minor details as are necessary to make a proper drawing. Above all let the student assume that his drawing is going into the shop to be worked from, and treated in all respects with no more care than any other working drawing. If there is any error or misunderstanding the draftsman alone is responsible; if the lines and figures become indistinct with shop use, it shows they should have been made heavier; if verbal or written explanations (other than the customary notes which appertain to a working drawing) are necessary, it shows an incomplete drawing; and it is the province of the instructor to see that these objects are attained. In this work the character of the examples may be very properly differentiated for the several departments of engineering.

In the present discussion of the subject we shall confine ourselves to such work as would be suitable for mechanical or electrical engineers.

Tracing and blue printing should be taken up at this time and the work of the term completed by a series of graded exercises in isometric drawing, line shading, and tinting. To carry this work through successfully will require from six to ten hours per week for twenty-four weeks.

At the beginning of sophomore year a short course should be given the student in descriptive geometry, including shades and shadows. The time devoted to this subject may vary from five to eight hours per week for sixteen weeks, two hours of this time being given to recitation-room work. Upon the conclusion of this subject our student should be given over a line of work preparatory to machine design. For lack of a better name we shall call this work the "mechanism of machinery." Its object is to study the nature, proportions, construction, and analysis of existing machines, and may be taught by means of lectures, inspection of the actual machine, and drawing-room exercises. Where possible the machine should be taken apart by the students and its several parts sketched. Visits of inspection to manufacturing works, in which the students may watch and note the more important methods of construction, constitute a part of this work. In the various machines inspected, the methods of oiling and adjustment, provision for taking up wear, extent of wearing surfaces, different metals used and reasons therefor, should not only be carefully pointed out to the student, but he should be taught to observe these features himself. By noting at the same time the widths of belt used and the speeds at which the machines are run, also the character and quantity of work turned out, the student is not only preparing himself for the immediate work of machine design, but he is acquiring habits of observation which will be an advantage to him throughout his entire career. The ability to get at the true inwardness of a machine by observation and analysis from point to point is not usually possessed by the untrained engineer.

Lectures on methods of handling and turning out work in machine shops and other works constitute a valuable feature of this subject, for even with the best of college shops and methods of instruction the student obtains but a limited knowledge of shop practice.

The object of the lecturer on this subject should be to point out ways and means, and to indicate where designs are defective; where they may be improved; where and why other proportions should be used; how parts may be changed so they may be constructed more cheaply; in short, as far as possible, in the limited time at his disposal, his object is to teach the more important principles which guide the successful engineer in his designing, so far as the constructive features are concerned. Mere statements and facts should be subjected to the idea of bringing out the reasons pro and con in any given case. Suitable exercises to be worked out in the drawing room should accompany this work. These may consist of combinations of several pieces shown in section and otherwise, so that the student learns the relation of the drawing to the *thing*, and in assembling these several pieces he learns the relation between the individual thing and the machine. For this work the exercises may be taken in part from sketches made by the student, and in part from the blue prints of details of machine parts which may be obtained from the manufacturer, or they may be taken from senior designs. This work should extend through to the end of sophomore year, or for a period of twenty-four weeks. One lecture, and from five to eight hours per week, inspecting, sketching, and drawing, may be very advantageously devoted to this subject. The student is thus prepared at the beginning of junior year to take up the study of machine design.

Machine design is both a science and an art. It is a science in that it is based upon rational deductions; it is an art in that it requires skill and judgment in applying these deductions to the engineering materials which are available. Calculation from a given formula is not machine design; judgment, or what has been termed "horse sense," enters quite prominently as a factor in the work. If calculation calls for a 60-inch boiler to be 2 inches thick, the designer must know intuitively that something is wrong. He should also be sufficiently informed on shop practice and methods that when he designs a piece of work he must know whether it can be made in the shop.

In the designing of new machines and mechanical constructions, the draftsman must draw from his knowledge of well-known forms and parts and combine them; but to proportion them properly and adapt them to the purposes required, he must take into consideration the stresses to which they are subjected, and the behavior of the available material under varying conditions. The choice of suitable dimensions and forms is the work of the machine designer.

Engineers and practical shop men are enabled to proportion the various machines which are daily manufactured, and to satisfactorily design new machines, without a knowledge of the character of the forces acting in the various parts of the machine; but it is safe to assume that this knowledge has been obtained only as a result of long experience and the process of substitution—that is, when a part failed in a machine a larger or stronger piece was substituted in the next one built—an expensive method of design.

The shop designer is frequently an averager, who obtains his results largely from the catalogues and publications of other manufacturers; and, while this is valuable as affording a means of comparison and corroboration, we believe that all intelligent mechanical design must be based on a knowledge of scientific principles. On the other hand, there is a difficulty in proportioning many machine parts on account of the lack of exact information, and of their variable functions not amenable to exact rules. For such cases empirical formulas and tables made up from the results of experiment and practice will be found of great assistance to the designer.

From these considerations it will be seen that the province of the instructor in machine design is to teach the principles available as guides in machine design, and to furnish such examples to be worked out at the drawing board as will ultimately tend to the development of the student's engineering knowledge. The teacher of machine design should evidently be a man familiar with practical shopwork and modern methods, but he should not attempt to cram the student full of facts and tables. If the underlying principles are made prominent let the instructor feel that his work is well done; for development into the full-fledged engineer can not occur at once. It takes time, and we must remember that there is inertia in mind as well as in matter.

The teacher of machine design must also guard himself against giving the student formulas without showing their derivation and the relation of the several factors involved. It is not teaching principles if we select a dozen or more formulas with constants already determined and say to the student: Draw a piston rod end, for instance, making the diameter of rod equal to one sixth of the diameter of cylinder. If this is the way to teach our boys, why not get out tables for general cases and put them into the hands of our students? The average student is a reasonable and a reasoning person, but even a student is limited in capacity. For this reason we should so much the more teach principles as foundations and let the character of the individual problems be determined by the ability of the man. It is unwise to gauge all men by the same standard, and the old saying, "You can't make a whistle out of a pig's tail," should constantly be borne in mind by the college professor who puts all his men through the same work in machine design and expects all to be equally gifted in designing. If a boy has capacity for engineering he may be given problems and designs to work out that a man of less natural ability could not possibly execute. Although natural aptitude is a great advantage in this work, much can be acquired, and the teacher must judiciously direct the work of each student in order that he may thereby the better prepare the individual for his future vocation.

Before entering upon the real work of the drawing room it is advisable to spend about three weeks in the recitation room (three hours per week) in a general discussion of the engineering materials and the principles and general rules of calculation which are applicable to problems that may arise in the determination of machine parts.

The subject-matter taken up under these heads is not intended to displace nor should it be substituted for the study of metallurgy and applied mechanics. The properties and strength of engineering materials and the principles relating thereto are to be considered as an equipment of suitable tools which will enable a man to intelligently design those simple elements of which a machine is composed. The hasty preliminary view of the field is merely to indicate to the student where these tools may be found.

From six to ten hours per week for twenty-eight weeks should be devoted to the design of machine elements, such as those which come under the head of fastenings, gearing, pulleys, shafts, and bearings. This may be followed by problems in kinematics relating to straight line motions, quick return motions, and various cam motions, after which practice should be given in the application of Zeuner's diagram to valve gears. Eight to ten hours per week for twelve weeks are necessary for this portion of the work. At the beginning of senior year steam-engine design may be taken up and carried on for sixteen weeks, seven to nine hours a week being necessary for the work. Upon its completion the student takes up the design of machine tools, boilers, pumps, clutches, hoisting, punching, and other machinery. The time allotted to this section of the subject should vary from eight to twelve hours per week for twenty-four weeks. It will be found that quite a number of men will even spend as much as twenty hours per week on this work if permitted to do so.

The method of teaching machine design as carried on at Purdue University varies with the character of the work. So far as possible the students are given individual problems so that each may make his own calculations and become familiar with the method and application of the formula involved. Preceding each new series of problems a short lecture is given to the class, in which are pointed out the underlying principles relating to the problems, and the derivation and application of the formula to be used are explained, and reasons noted why other proportions should be adopted under other conditions. In these problems each part is designed to do some definite work for which the data are given or may be determined.

Upon the completion of these elementary problems the student is given a course of exercises in kinematic and valve-gear problems, as previously indicated. With the commencement of senior year he takes up steam-engine design. In this work a given horse power of engine is assumed, suitable limits are chosen, and the indicator cards drawn for minimum, maximum, and normal conditions. These diagrams are modified to conform to practical conditions; and the diameter, length of stroke, and speed of the engine are determined after the tangential pressures upon the crank pin have been ascertained from assumed inertia effects. Instruction is given by means of lectures and drawing-room notes. Each student makes a complete set of theoretical diagrams in pencil on sheets 24 by 36 inches (standard size for senior drawings), after which the details of the engine are worked up by ths class collectively—one man takes the cylinder, another the bed, another the crosshead and connecting rod, and so on. In designing these details the student has access to a good reference library in the drawing room and a very complete collection of trade catalogues and working blue prints from manufacturers, so that he has every means of becoming informed in regard to current practice.

In the design of details and in machine drawings which follow this work, the tracings are made direct from the penciled drawings. When completed, each student obtains a full set of blue prints. Conventional shop practice is used throughout all the work in machine design, and this is especially emphasized during the senior year where greater occasion for its use arises. For calculation and preliminary notes a system has been adopted by which the work and results are kept distinct, and yet both are preserved for future reference or comparison. The advantage of any such system in locating errors is apparent. In the present case notes, formulas, and results are kept on one page, while the calculations are made on the opposite page, so that the work and results are together, yet distinct. No attempt is made to economize paper, the only object aimed at being to save time, and this is best obtained by teaching the student to systematize his work and have the calculations where they may be referred to in case of error or in checking results. During the progress of the work, especially in scale drawings, the draftsman is encouraged to make full-sized sketches of the several parts of his design in order that he may obtain a better degree of proportion. To this end, specially prepared section paper is provided, so that the part may be rapidly sketched in freehand without other reference to size than that furnished by the paper itself.

The concluding work of the senior year consists of special designs, assigned individually, according to ability and circumstances. This work is generally presented in the form of a problem which involves more or less engineering knowledge and the exercise of judgment in the application of principles studied earlier in the course. Time blanks are used for these designs, as it is thought that a record of the work and time spent on it is advantageous to both student and instructor. Instruction is given in this work by means of consultation with the student, advice, and corrections. References are cited when the problem is assigned. As the design progresses many of the details are sketched off and worked up by under-classmen. For this purpose several of the more advanced freshmen and sophomores are detailed as assistants to the seniors, and from an experience of two years the plan can be indorsed as producing excellent results. The senior is given a responsibility which insures greater care and thoroughness on his part, besides which it enables him to accomplish a great deal more of real shopwork than would otherwise be the case. There is also an advantage to the under-classman, as he is brought more intimately in contact with a class of work as nearly as possible similar to that carried on in engineering drawing rooms.

Recapitulating and taking the average time allowance, it will be seen that we advocate a course in mechanical drawing covering four years and occupying a total of 1,168 hours, allotted as follows:

Hours occupied in mechanical drawing.

Class.	How occupied.	Hours per week.	Number of weeks.	Total hours.
Freshman year	Freehand drawing and lettering	6	16	96
	Instrumental drawing: Tracing, blue printing, shading, tinting, isometric.	8	24	192
Sophomore year	Descriptive geometry, shades, and shadows	6	16	96
	Mechanism sketches, assembling, and section drawing.	6	24	144
Junior year	Design of machine elements, cam motions, and valve gears.	8	40	320
Senior year	Steam-engine and machinery design	8	40	320
	Total			1,168

APPENDIX.

MINUTES OF SECTIONS.

SECTION ON AGRICULTURE AND CHEMISTRY.

The Section on Agriculture and Chemistry held but a single meeting, in which the only work done was to elect officers for the coming year.

SECTION ON COLLEGE WORK.

Much of the work usually coming before this Section during the annual conventions of the Association was merged with that of the various agricultural congresses in session at the same time and place. Two sessions only of the Section were held.

The first session was called to order at 11 a. m., October 17, President Dabney in the chair. The secretary of the Section, President Fernald, of Maine, being absent, President Stockbridge, of North Dakota, was elected to serve in his place. The report of the president of the Section, Dr. Dabney, read in the general session of the Association, was brought up for consideration. On motion of President Scott, of New Jersey, it was voted that the report of the president be referred to a committee of three, with instructions to embody the recommendation of the report and those of the Inspector General of the Army on the same subject, namely, military instruction in land-grant colleges, in a resolution to be presented to the War Department as the sense of the Section. Messrs. Scott, Welborn, and Harris were named as such committee. The Section then adjourned.

The second meeting of the Section was called to order at 12 m., October 18, President Dabney in the chair. No business was brought up except the election of officers for the ensuing year, resulting as follows: President, President Fairchild, of Kansas; vice-president, President Harris, of Maine; secretary, President Stockbridge, of North Dakota. The Section then adjourned *sine die.*

H. E. STOCKBRIDGE,
Secretary.

SECTION ON HORTICULTURE AND BOTANY.

The following papers were presented by Prof. B. D. Halsted, of New Jersey:

THE SOLANDI PRINTING.

By B. D. HALSTED, *of New Jersey.*

Your worthy secretary suggests that the papers before the Section be mainly upon methods and plans; therefore the following process of making records of various results is given. It was given at the Madison meeting of the American Association for the Advancement of Science, but as many of the station botanists and horticulturists were absent, and because several have expressed an interest in the process, it is again stated in brief: It is a process of sun printing, and can be employed for any subject not too thick or dark to admit the passage of light. With leaves and objects similar to them it is particularly well adapted. The process consists in exposing an object like a leaf, for example, to the sunlight while closely held upon sensitized paper, the aristotype paper being the kind most experimented with in an ordinary photographer's printing frame.

This sun print thus obtained is toned in the same way as an ordinary photograph print. This print becomes a negative, from which a positive is printed. To do this the negative is placed in kerosene for a minute, wiped clean, and put in a printing frame, faced by aristo paper. This positive is toned in the same way as was the negative, and the work of taking a picture is finished, and, if well done, there is an exact reproduction of very many of the details of the subject.

If green leaves or subjects be taken fresh, they need no previous treatment, the only precaution being to have them dry upon the surface exposed to the aristo paper. When dry subjects are used, they may be placed in the kerosene for a short time, which only makes them more translucent in the lighter parts and facilitates the printing.

There are many subjects that yield better results by the Solandi process than by photography. The former is by transmitted light, and brings out some of the peculiarities that lie beneath the surface and are not, therefore, secured by photography.

The cheapness and ease of the process commend it to everyone who desires exact prints of various objects. There is no camera needed, no sensitized glass plates, or even a dark room. A photographer's printing frame and a few cents' worth of aristo paper are sufficient to secure a dozen pictures. The toning is easily done, costs but a little for a hundred pictures, each one of which is absolutely natural size and the details represented without distortion.

Samples of the work are shown, and they must speak for the process.

FIELD OBSERVATIONS WITH FUNGI.

By B. D. HALSTED, *of New Jersey.*

The study of destructive fungi has been confined very largely to the laboratory. This has been as it should be, for it is only with the compound microscope and various methods of tube and plate cultures that the nature of the pest may be determined. It seems to me that this indoor work with many of the parasitic fungi has gone far enough to be at least supplemented by observations in the field. While it is well to study the fungi minutely and separately, often the best results, particularly from a practical standpoint, are to be derived from careful and continuous field observations.

The following instance may help to enforce the above, and, while it is drawn from my own notebooks, it serves the purpose of calling the minds of other students of similar subjects to the importance of making similar observations:

In 1892 a laboratory study was made of the quince diseases, and particularly one known as the black rot, then very destructive. The miscroscopic study developed strong suspicions that the fungus was the same as that causing a similar decay of apples, namely: *Sphæropsis malorum* Peck. Inoculations were easily made from the quince to the apple and *vice versa*. Having established the identity of the black rot of the quince and apple by laboratory methods, attention was turned to the orchard, when it was soon found that one apple tree standing near the center of the grove of quince trees and loaded with fruit abounded with the *Sphæropsis* while the quinces nearest to this tree were the most affected. It was then found that the same relations existed between a similar rot of pears and the above-mentioned apple tree, and this decay was shown by inspection and cultures in the laboratory to be due to the same fungus. These are instances of important information, aided by field observations, and are introductory to a study that was made in the same field early in the present season.

Feeling assured from other experiments of the value of beginning in time the apple tree was visited in June, and this proved none too soon. One large branch loaded down with fruit was a graft of the Red Astrachan, and at that time many of the fruits were decaying upon this branch, while those upon the other portions of the tree were yet small, green, and sound. This fact of observation taken with those of last season, in this single branch of the Red Astrachan, was the beginning of the serious trouble from black rot in the orchard and particularly with the quinces. In other words, while in 1892 the field observations traced the possible source of the rot to a single apple tree, those of the present season pointed out that the *Sphæropsis* started and gained headway in the early maturing fruit of a single large branch of that tree.

From the remedial standpoint the suggestion comes naturally that either the whole apple tree should be removed—that was the advice given last year—or the branch of the early sort cut away. This latter may prove to be the desired check and should be tried. This is a case of saving the life at the expense of the limb and comes under one of the rules of modern advanced surgery.

If our knowledge of the field habits of fungi were better known examples similar to the one cited might be given without number.

At the present time the writer is attempting to gather information upon the relationship which one cruciferous crop bears to another in the matter of clubbing of the roots, due to the low fungus *Plasmodiophora brassicæ* Wor. It seems to prefer the roots of the cabbage, but within the past month most aggravated cases of it have been found upon turnips. Radishes are least affected, and the point of observations is to see how much risk is run by growing turnips after cabbage and radishes after either, also how long the fungus may remain virulent in the soil. Not the least item in the examination of the roots of wild weedy *Cruciferæ*, as suspicion rests upon them as the "common carriers" of this underground enemy.

A final suggestion in the matter of an appeal for more field study of fungi is that of coöperation. The time element is the only one that stands in the way of botanists from Maine to California working together upon some problems requiring only the use of the eyes while in the field, orchard, and garden, and recording the facts so obtained. In laboratory studies we can not expect to coöperate largely, but in field observations there is no barrier against it. Therefore let us do more field work with fungi at odd hours, mingled with recreation at times it may be, and labor helpfully together upon some of the numerous subjects that can not fail to interest many if not all the station botanists and horticulturists.

SECTION ON MECHANIC ARTS.

According to the plans of the Association, the Section on Mechanic Arts of the Association of American Agricultural Colleges and Experiment Stations held its first annual meeting in Hall IV of Art Palace, on Michigan avenue, Chicago, on Wednesday evening, October 18, 1893.

The meeting was called to order at 7:15 p. m. by Chairman C. W. Hall, of Minnesota. This meeting being the first held by the new Section, no minutes were read.

Prof. C. W. Hall, of Minnesota, presented a paper on "Some Relations of Mechanic Arts to Agriculture." The production showed concisely how intimate the agricultural and mechanic arts were and how they could assist each other in individual development. The paper created considerable discussion and a free exchange of opinions regarding manual training operated in connection with agricultural colleges.

In the absence of Prof. G. W. Bissell, of Iowa, his paper on "Shop-work at the Iowa Agricultural College" was read by the secretary of the Section.

Prof. Bissell outlined the system of shop instruction at the Iowa Agricultural College, and illustrated his methods by a very complete set of blue prints.

Although the article was specific, the presentation of the exercises used in one college was fruitful of interesting discussion.

On motion of Maj. H. E. Alvord, the papers read were ordered incorporated in the general proceedings of the Association.

On motion of F. P. Anderson, the three remaining papers on the program were read by title and referred to the executive committee of the Association for publication.

The other papers prepared for the Section on Mechanic Arts, and which were referred for publication, are:

"Mechanical Drawing in Technical Schools," by Prof. J. J. Flather, of Purdue University.

"Manual Training and the Apprentice System," by Prof. C. Russ Richards, of University of Nebraska.

"What Tools are Necessary in a Manual Training Course," by Prof. H. E. Smith, of University of Minnesota.

In the general discussion following the reading of the papers some interesting questions were examined relative to the amount and character of shopwork that should be given to agricultural students. Expressions of opinions came from Maj. H. E. Alvord, Prof. W. C. Latta, of Indiana; Prof. Lewis McLouth, of South Dakota; Prof. J. H. Washburn, of Rhode Island; Prof. C. W. Hall, of Minnesota; President A. W. Harris, of Maine; and Prof. Hugh Jamieson, of Louisiana.

The qualifications of instructors in shopwork were freely discussed, the universal opinion being that a man having a practical shop experience, together with that training received in a technical school, is the most desirable instructor in manual training.

No further business was transacted, and the first meeting of the Section on Mechanic Arts, considering the diverting influences of the Columbian Exposition, proved very successful.

F. P. Anderson,
Secretary.

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